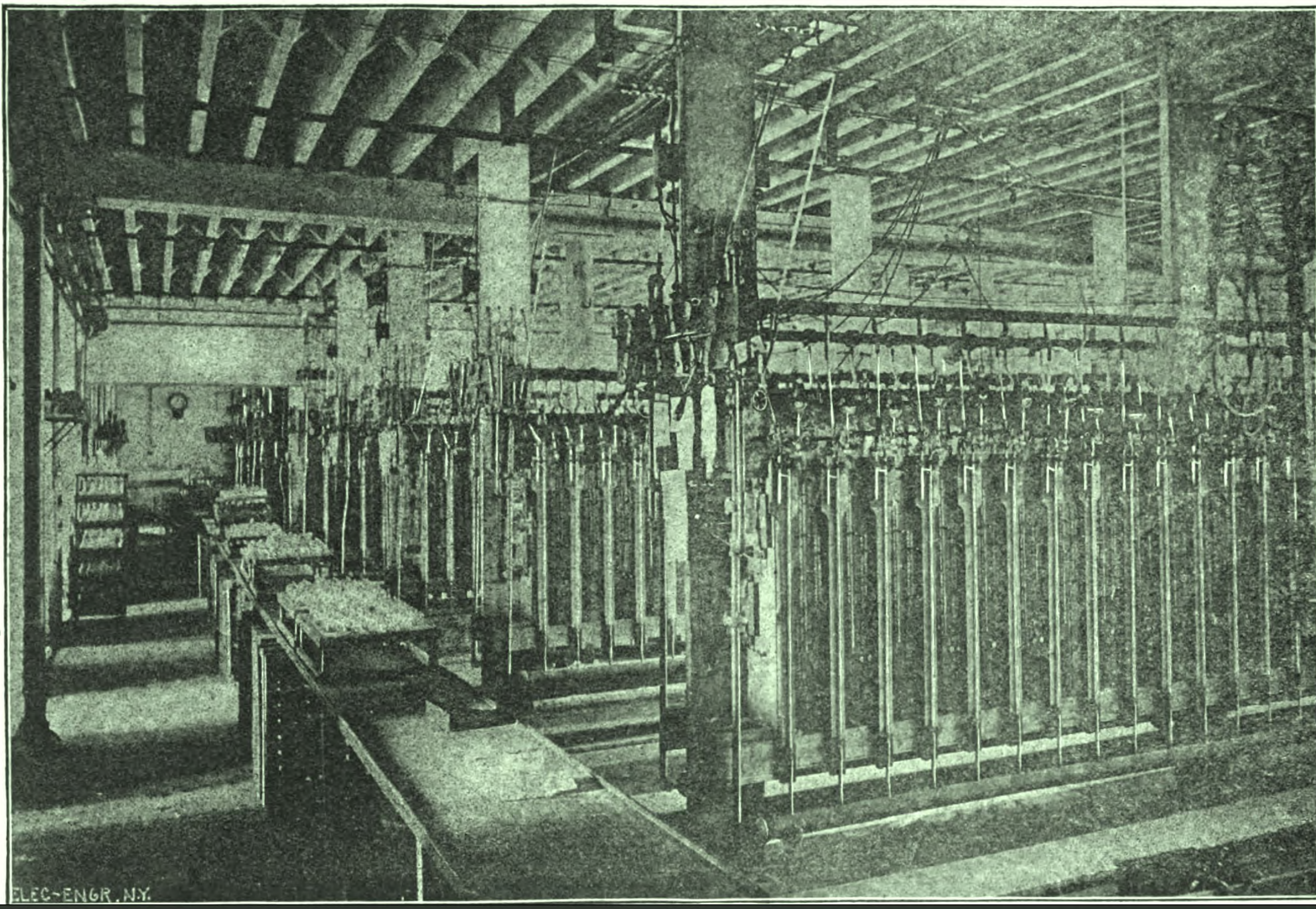

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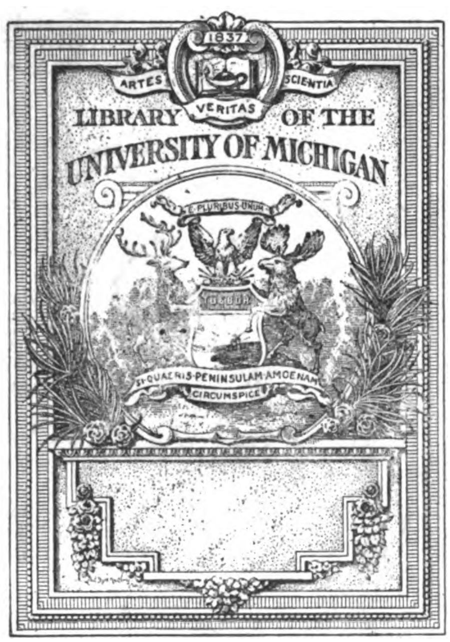
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THE

Electrical Engineer.

A Weekly Review

OF

Theoretical and Applied Electricity

VOLUME XIX.—1895.

(January to June.)

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Alphabetical Index of Contents.

A denotes Articles. **Ax** denotes Abstracts and Extracts. **E** denotes Editorials. **L** denotes Letters to the Editor.
L N denotes Legal Notes. **N** denotes News and Notes. **T N** denotes Trade Notes and Novelties and Mechanical Department.
An Asterisk (*) denotes Illustrations.

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THE
Electrical Engineer.

Vol. XIX. JANUARY 2, 1895. No. 348.

THE MAKING OF AN INCANDESCENT LAMP.

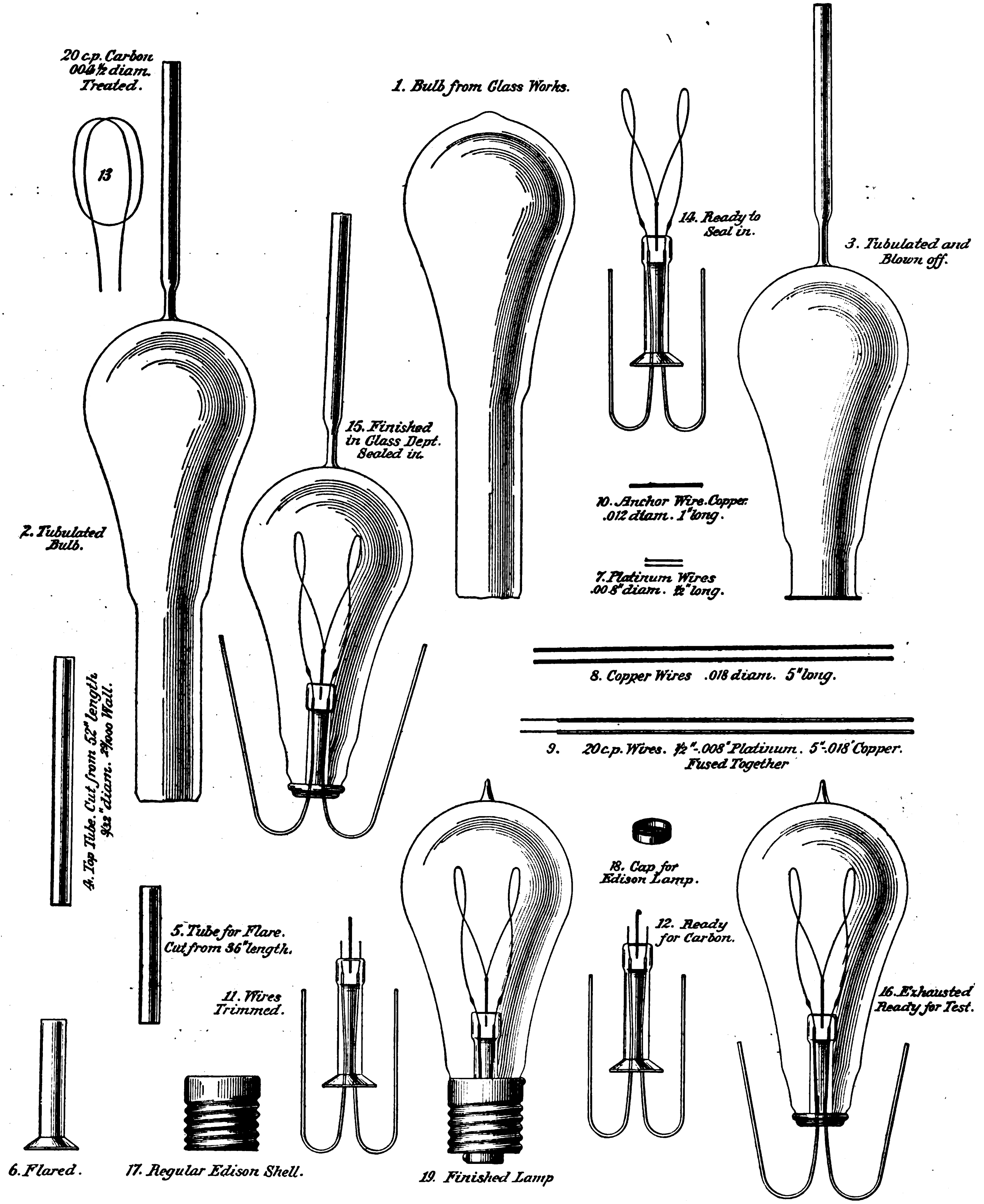
THE recent remark of Mr. Edison that what the public wants and what the central station ought to sell, is light, and not current, carries with it a deeper import than would appear on the surface. Aside from the economical question involved, it means that however much we may strive to improve the methods and apparatus for generating and distributing current our efforts will be of little avail if the lamp fails of its true function. And this brings us once more to the consideration of the very essence, the soul, of incandescent lighting, the lamp, around which all the other details of current production revolve as satellites to a central sun. To the incandescent lamp then we must turn as the ultimate instrumentality by which the success or failure of incandescent lighting must be gauged. If this view of the question be admitted then the methods and processes which are applied to the making of an incandescent lamp occupy a position of paramount importance in the art and a description of them as practiced to-day will, we are sure, prove of interest.

Electric incandescent lamp making on a commercial scale dates back to 1880, when Mr. Edison, at Menlo Park, after his historical labors, finally succeeded in obtaining a lamp that would burn several hundred hours, before destroying itself or rendering its further existence of no value. It would read like a novel were we to recount the history of the search for the best filament material, and how the earth was literally ransacked until bamboo of a certain type was adopted,—how the standard potential of 110 volts came to be chosen,—what reasons dictated the shape which the incandescent lamp now universally assumes,—and many other equally important details; but our object is to describe the lamp as we find it to-day and to give our readers some idea of the processes employed in its manufacture, as carried out in the largest lamp factory in the world.

THE GLASS ROOM, GENERAL ELECTRIC COMPANY'S LAMP WORKS, HARRISON, N. J.

The General Electric Co.'s Lamp Works are situated at Harrison, N. J., directly opposite Newark, N. J. It was in 1882 that Mr. Edison transferred the lamp works from Menlo Park to Harrison, occupying for that purpose a single building. As time passed and greater facilities were made necessary the works were enlarged until to-day the various departments cover an entire square with an annex in which the power plant is located.

A glass bulb, a thread of carbon, two short lengths of platinum wire and two of copper, and two shells of brass with a little cement constitute the entire *matériel* of the incandescent lamp; and yet no less than 41 different hands (not including inspectors or those who carry lamps



THE INCANDESCENT LAMP FROM START TO FINISH.

from one place to another), each having a separate and distinct piece of work to perform, fashion and shape these before the lamp is ready to be placed in the socket. As we pass through the factory and trace the work from step to step, the processes will be made more clear by means of the engraving on this page, to which we shall refer by the sketches numbered thereon.

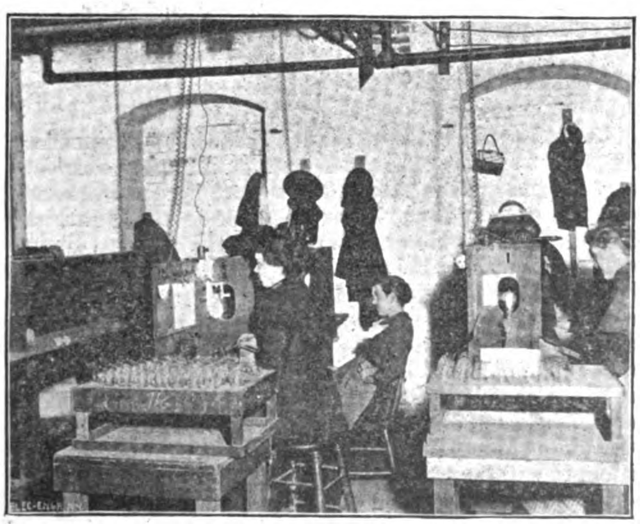
The bulbs destined for the lamps are procured from a number of glass works, and as they arrive at the factory have the shape seen at 1, which shows a neck of con-

siderable length added to the bulb as it appears in the finished lamp. These bulbs are made of a particular kind of soft lead glass and for a long time after the manufacture of incandescent lamps was begun on a commercial scale it was deemed best to adhere to the free blown bulb. But, though the accuracy with which the blowers perform their work is truly marvelous, the variations were, nevertheless, such as to require the sorting of the bulbs into groups, varying in size a few hundredths of an inch. At present the bulbs are blown in a mold, which ensures absolute uniformity and makes the subsequent work in fitting and mounting the base very much easier than had been possible in the past. The tissue paper wrappers which keep out the dust from the inside having been removed, the bulbs are washed in water and then inspected for cracks, short necks, creases, streaks, sand knots, etc.; all bulbs showing deficiencies of this nature are thrown out.

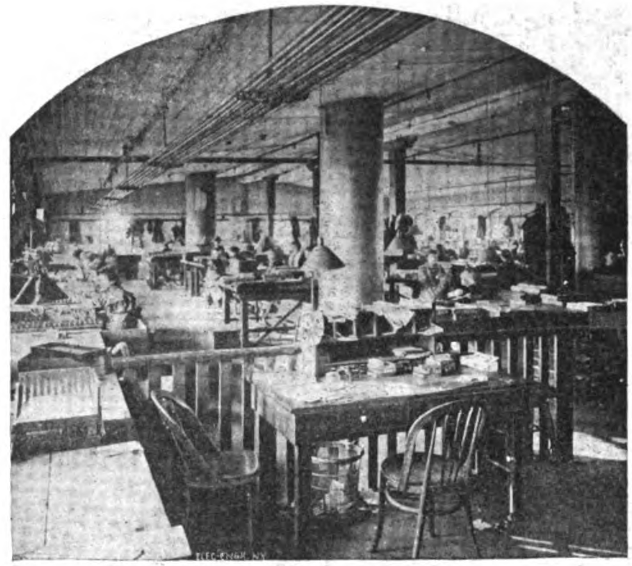
The bulb then passes into the hands of the glass blower who tubulates it by fusing into the top a length of tubing cut from 52-inch length, having an inside diameter of $\frac{9}{32}$ of an inch and a thickness $\frac{22}{1000}$ of an inch. The lamp then appears as shown at 2. This operation of sealing in the top tube requires the most skilled labor in the factory as the work must be done very neatly in order to avoid distorting the bulb. After being tubulated it passes to another set of glass workers who blow off the end of the neck, leaving a short length slightly flared, which forms the neck into which the mount holding the filament is fixed later on, as shown at 3.

The only other glass part of the lamp, the mount, is made up of a tube inserted at the lower end and which is cut from tubing 36 inches in length. The first operation to which these short lengths of tube are subjected is the flaring of the end which is to be fixed into the neck of the bulb. For this purpose the short tube is revolved in the lathe with the gas flames playing against the end. A tool brought up against the heated ends gives it the shape shown at 6.

To complete the mount, there are still necessary a pair of copper wires $\frac{18}{1000}$ of an inch in diameter and 5 inches long, to which a $\frac{1}{2}$ inch length of platinum wire $\frac{8}{1000}$ of an inch in diameter is fused. This operation is performed very deftly by girls. With the platinum ends projecting beyond the end opposite the flare and with the anchor wire of copper an inch in length also held in the centre of the tube, the latter is again fused and the three wires are fixed firmly in place by pinching the glass and flattening it around them. The ends of the wires are then trimmed to standard length, the anchor filament hooked at the end, and the mount is ready for the filament, as shown at 12.



VIEW IN THE PHOTOMETER DEPARTMENT.



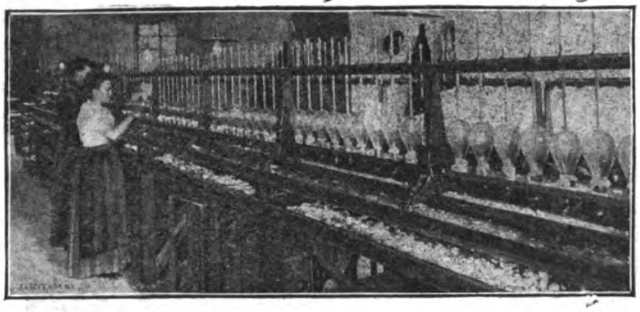
VIEW IN THE CLAMP ROOM.

Until quite recently the only material employed for making filaments was that which Mr. Edison had found to be the best for the purpose, namely, bamboo, but while it possessed excellent qualities for that purpose, later developments have brought to perfection methods which have now entirely displaced the bamboo filament. The reasons which have dictated this change are, first, the difficulty which has always been experienced in obtaining long, thin fibres of uniform section from bamboo, and, on the other hand, the cost of manufacture. The filament at present employed has, as its base, a very pure quality of cellulose.

In order to reduce this material to a condition suitable for working into filamentary shape the cellulose is partially dissolved into a stiff, jelly-like mass. This solution is then forced through a die having a diameter adapted for each varying size of filament. The thread as it emerges from the die passes into a glass jar filled with alcohol, which hardens it. The wet thread which stands handling very well is now wound on drums and dried, and in that condition is ready to be carbonized. For this purpose the thread, cut to the proper length, is wound on a form which has the shape which the filament is required to have when carbonized. In order to ensure uniformity of product, the filament, as it comes out of the carbonizing furnaces, is gauged by a screw caliper to one-quarter of $\frac{1}{1000}$ of an inch, and then cut off to the proper length suitable for each type of lamp.

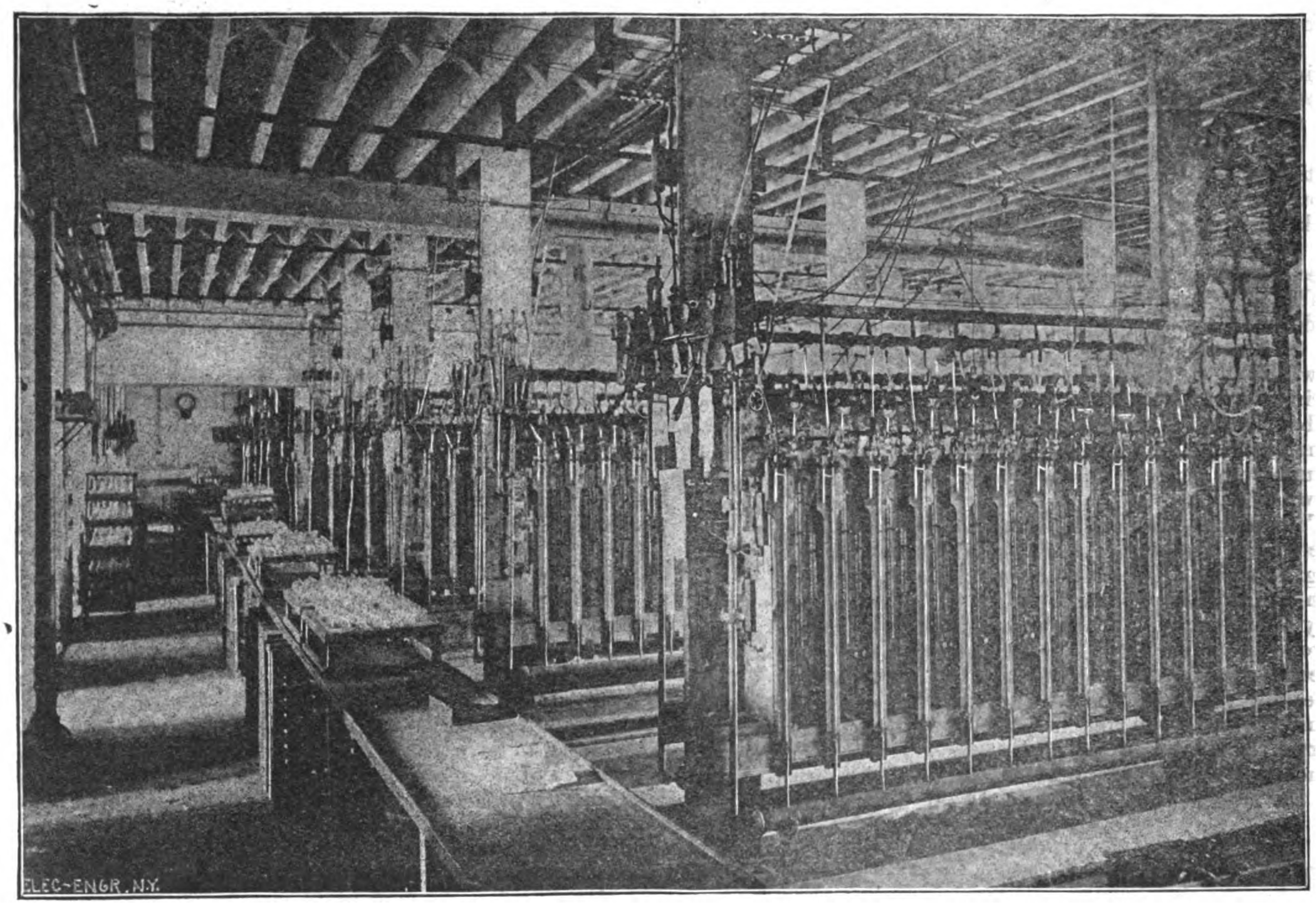
The thread from which the filament is made must, of necessity, be of great uniformity, and while the greatest care is taken to obtain uniformity of temperature in the carbonizing furnaces, it is obviously impossible to obtain that exact correspondence of resistance between many thousands of filaments, which is necessary for lamps intended to be placed on circuits of the same potential. For this purpose it is necessary to treat the carbon filament by flashing in a hydrocarbon gas. This work is carried on in the department shown on page 6 and is done automatically. The girl, seated before a pair of flasks, inserts the carbons, admits the hydrocarbon vapor, and by turning on the current the filament is heated to incandescence and decomposes the gas, which deposits carbon on it until the filament is reduced to the proper resistance. When this point is reached the current is automatically cut out and the depositing action ceases.

In this department also we notice the operation of joining the platinum leading-in wires to the heavy filaments required in some types of lamps. This cementing is accomplished by placing the carbon filament and platinum wire in contact under naphtha and sending a current



FIXING THE BULBS IN THE SOCKETS.

through them. The heat developed at the contact points decomposes the naphtha and deposits carbon which cements ing the filaments to the leading-in wires. For this purpose one set of operatives applies a small drop of liquid carbon cement to the ends of the leading-in wires, and the stem then passes to another set of operatives, who place the ends of the filament in contact with the leading-in wires, the liquid holding the filament in place by adhesion. Another set of operatives applies a thick cement, which gives the joint a body. The same cement is also applied to the loop of the filament where it is held by the anchor wire. After straightening out the wires and shaping the filament, the mount has the appearance shown at 14, and is ready to be sealed into the bulb. For this purpose the bulb and the stem are mounted in a lathe and revolved as the flame plays against the neck. The two glass surfaces are slightly pressed and the seal made perfect, giving the lamp the appearance shown at 15, with the copper connecting wires projecting from the end.



VIEW IN THE PUMP ROOM OF THE GENERAL ELECTRIC LAMP WORKS.

the two together. This process is carried out by means of the alternating current, which is regulated by means of a choke coil. This type of regulator is also used in the regulation of the current in connection with the flashing process, its use being preferred to that of the rheostat, owing to its simplicity and to the finer gradations which can be given to the current by its use. The supervision of this department is not less rigid than in the others. Each girl is furnished with 250 filaments at a time as they come from the carbonizing furnaces, every one of which has to be accounted for, and the good ones returned with those found to be defective. In this way a check is not only kept upon the workers in this department, but on those of all the other departments which have preceded this one in the handling of the filaments.

With the stem and the filaments complete the two are now ready to be joined. This is accomplished by cement-

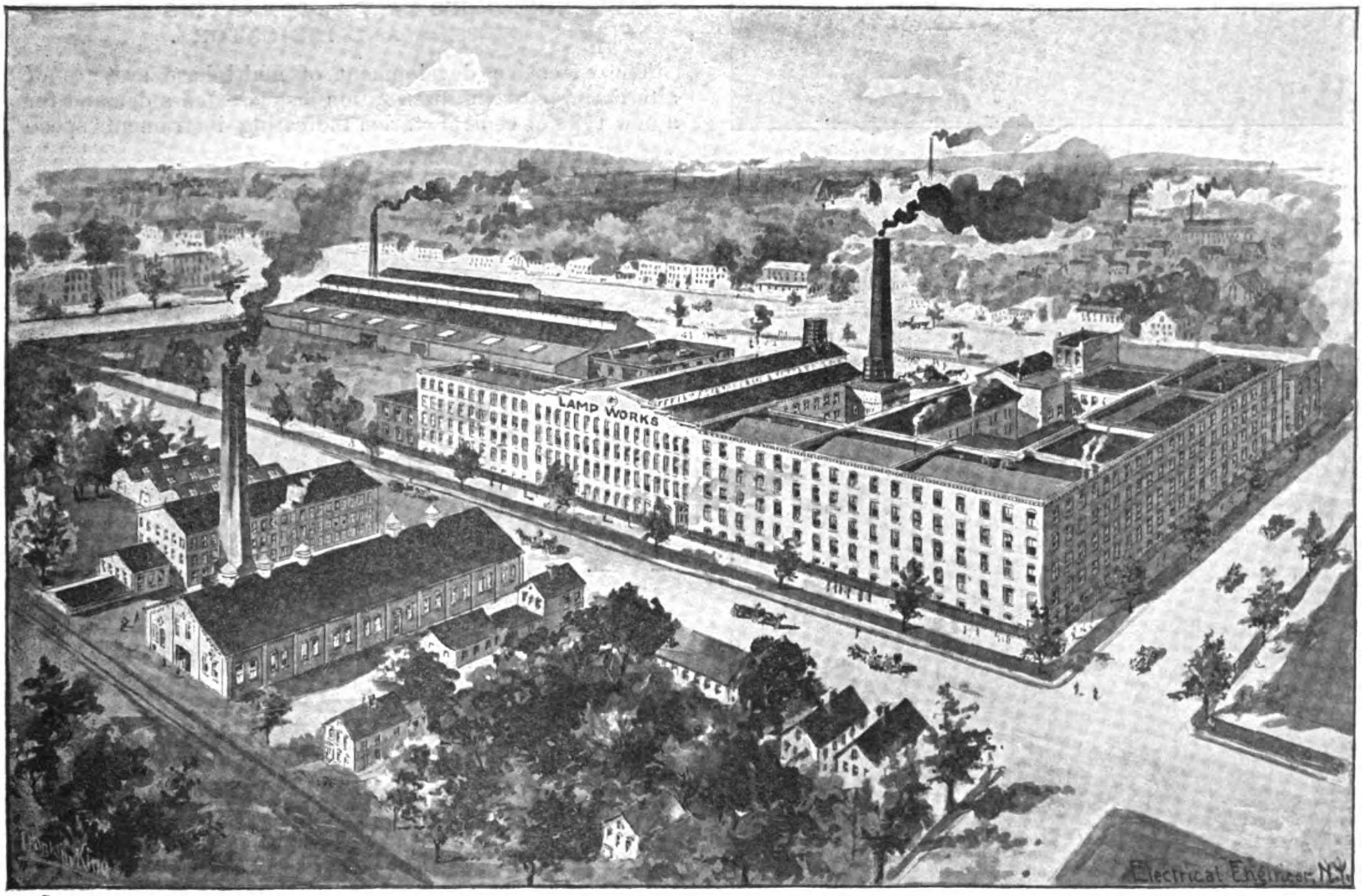
The room in which these glass working operations are carried on is shown on page 1 and is, in many respects, a notable sight. Over 240 operatives are here at work, and the shades drawn down so as to exclude the light, the hundreds of blue pointed flames, and the general silence pervading, give the whole an weird and uncanny aspect.

While all the operations which we have described require more or less skill and the exercise of great care, the lamp has still to undergo a process upon which its future life depends in the highest degree, and that is, the final removal of the air from the bulb. The exhausting department is, therefore, hedged about with special safeguards. Our illustration on this page shows a section of the pump room in which, it will be noted, the Sprengel pump is employed. The advantages attached to this pump are, that the attendant can at all times see how the process of exhaustion is advancing by watching the bubbles in

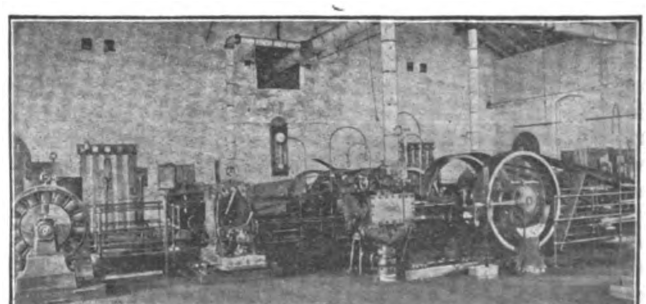
the tube. It will also be noted that, contrary to the practice by which a number of lamps are joined together in a bunch for the purpose of exhaustion, at the General Electric Lamp Works each lamp is individually connected to the pump. The object of this is, in the first place, to avoid the extra work entailed in bunching the lamps, and, in the second place, it makes it possible to distinguish a leaky lamp almost the instant it is placed upon the pump, by watching the bubbles. Where a half dozen lamps are joined into a bunch, a leak in the bunch cannot be determined so quickly; and when it is, there still remains the necessity of searching out the leaky lamp and removing it from the bunch. All this, of course, involves delay, which is not incurred where each lamp is exhausted individually.

When the lamp is first put upon the pump, a very few minutes suffice to extract a large percentage of the air, which is made manifest by the smallness of the gas bubbles descending in the mercury tube. When this preliminary exhaustion is completed, the current is turned on and the filament brought to low incandescence, which expels the occluded gas. The volume of gas occluded in the filament is truly remarkable and is immediately made evident by the large bubbles which pass down the mercury tube as soon as the current is turned on. The current is gradually increased until at the end the filament is flashed way above its normal brilliancy, in order to get out the last trace of gas. The exhaustion being complete, the lamp is then sealed off at the top and removed from the pump, having the appearance shown at 16. In a pump room of this size, requiring the raising of large quantities of mercury, which must be kept pure and free from all admixtures which might leave deleterious products in the bulb of the lamp, it is necessary to adopt special precautions. In the present instance, excellent results have been obtained by raising the mercury by means of an Archimedean screw, which is hermetically sealed in a cylindrical case and driven by a shaft projecting through the ends of the cylinder. No lubricant can, therefor, come into contact with the mercury, which remains pure for an indefinite period, and the simplicity of the Archimedean screw makes it possible to run it practically without any attention whatever. After the lamps leave the pump room they are tested to determine the quality of the vacuum, which is performed by the well-known spark coil test. The girl, placed in a darkened chamber, touches one of the lamp terminals to the terminal of a spark coil having a half-inch gap. A glow in the lamp indicates a poor vacuum and the lamp is put aside.

After passing the spark coil test, the lamps are ready to have the bases put on them. The Edison base consists of two parts; one, the shell, shown at 17, and the other the cap, 18. One of the terminal wires of the lamp is drawn

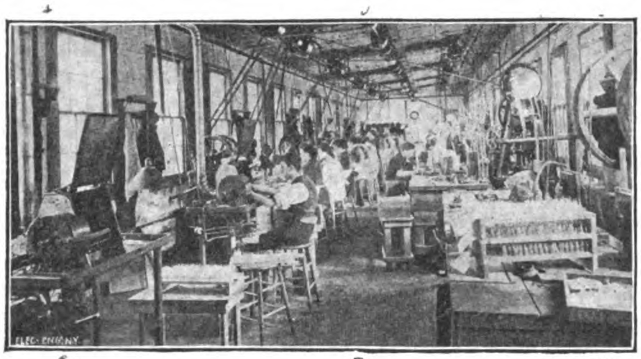


The General Electric Company's Incandescent Lamp Works, Harrison, N. J.



Interior of the Power House

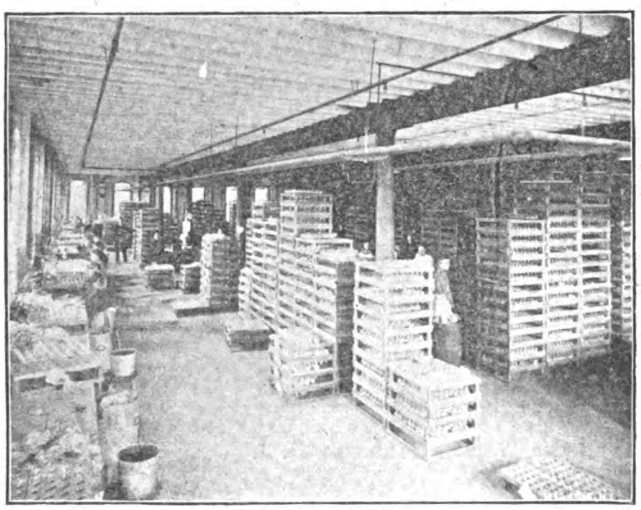
through the base, which has the cap held in position at its centre in a suitable mould. The latter is then filled with plaster of Paris and the bulb forced down into it, squeezing out the surplus plaster, the bulb being held in position until the plaster has set, which occupies but a few minutes. The mold around the base is then opened and the superfluous plaster adhering to the bulb is broken off. It still remains to solder the terminal wires to the base and the lamp, so far as its mechanical construction is concerned,



VIEW IN THE FILAMENT FLASHING DEPARTMENT.

is now finished and presents the appearance shown at 19.

But there still remains the work of sorting out the lamps into groups and marking them with the voltage at which they give the candle power for which they are designed. These photometric tests are performed by sets, two operatives working together. One seated in front of the photometer discs varies the potential at the lamp terminals until the discs show it to be at standard candle power. When this point is reached her companion reads the



THE SORTING AND PACKING DEPARTMENT.

voltmeter and ammeter and marks their indications on the lamp. The standard of light used in the photometer is the incandescent lamp and the lamps that are used for the actual tests are checked by another standard lamp after every 50 lamps have passed through the photometer. These test lamps are standardized in the testing department and are again made to accord with the final standard lamps kept at that point and determined with great care by actual comparison with the standard candle. From the photometer the lamps now are carried in racks to the stock room where they are cleaned, sorted out according to voltage, labelled, again inspected, wrapped in tissue paper, and finally barreled for shipment.

Besides the standard lamps, the manufacture of which we have just described, mention must also be made of the candelabra, special series, and miniature battery lamps for all conceivable purposes, which are also made here, and which are constantly growing in the extent of their application.

Some idea of the magnitude of the operations carried on in the works may be obtained by mentioning the fact that they are turning out 28,000 lamps per day of 10 hours, and that the power plant contains three engines aggregating over 500 H. P. The number of employees at work at the present time is 900.

In conclusion we desire to express our thanks to the General Electric Company, through whose courtesy we are able to place before our readers this account of their methods of lamp manufacture.

SHALLENBERGER'S NEW ALTERNATING CURRENT METERS AND INDICATORS.

The extensive development of multiphase systems of alternating current distribution has created a demand for a new type of central station indicating instruments speci-

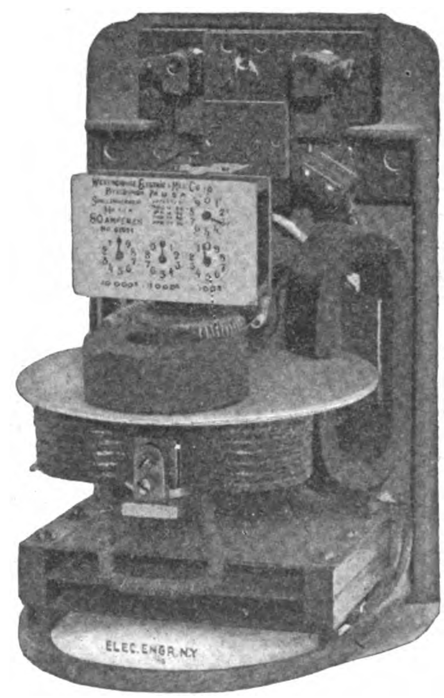


FIG. 1.—THE SHALLENBERGER MULTIPHASE INTEGRATING METER.

ally adapted for such currents, and also for an integrating and recording meter, adapted to the requirements of the various types of multiphase motors now coming into general use.

This work was taken up by Mr. Oliver B. Shallenberger at his laboratory in Rochester, Pa., with special reference to the requirements of the Niagara Falls plant, now being installed by the Westinghouse Company, and with a view to producing, if possible, instruments dependent purely upon the inductive effects of multiphase currents, so as to avoid the necessity for moving contacts or connections of any kind to the movable portions of the instruments. In this respect he has followed the general plan of his now well known alternating current meter, and has succeeded in producing a distinct group of instruments, all of which depend for their action upon the induction of currents in a movable closed secondary, and all operate more or less upon the same principles specifically developed in each. The instruments comprise an alter-

nating current voltmeter, an amperemeter and a watt indicator and intergrating wattmeters for both multiphase and single phase currents. They are the result of a long series of experiments, and embody a number of novel features both in principle and form. While designed particularly with reference to commercial uses, they are well

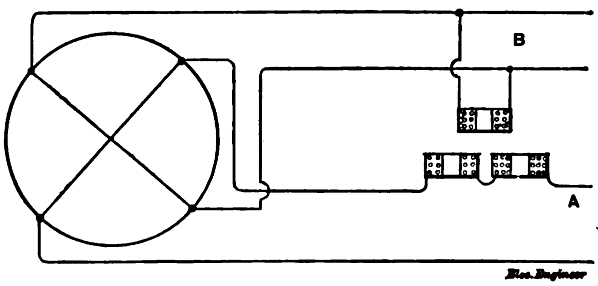


FIG. 2.—DIAGRAM OF 2-PHASE INTEGRATING METER.

adapted also for laboratory work, since they are capable of giving very accurate results.

The multiphase wattmeter shown in Fig. 1 in its integrating form, and in Figs. 5 and 6 as a central station indicating instrument, is typical and has been selected for illustration. A thin aluminum disc, stiffened by a bead or flange around its edge constitutes the movable element, in which eddy currents are induced by the currents traversing the coils placed above and below it. The upper coil is connected as a shunt and the lower coils in series with the work-circuit as shown in Fig. 2.

A and B are two-phase circuits. The series coils are connected in circuit A and the shunt coil across B through a resistance without self-induction. The currents in the two sets of coils are therefore in quadrature when there is no lag in the work-circuit, and would be exactly in phase with each other with a lag of 90 degrees in the work-circuit. The difference of phase between the currents in the meter coils is thus complementary to the lag angle of the work current. The conditions are such in the organization of the meter that the torque exerted upon the disc is proportional to the sine of the angle representing the difference of phase between the shunt and series currents, and therefore to the cosine of the lag angle of the current in the work-circuit; that is, the power factor. The torque is also directly proportional to the product of the shunt and series currents, so that it varies directly as the power transmitted.

The permanent magnets shown at the rear in Fig. 1 embrace the disc between their poles and cause a retarding force directly proportional to the rate of rotation, so that the speed is proportional to the power. The law of operation is as definite as that of the Siemens dynamometer and in the actual instrument can be carried out with greater accuracy, owing to the absence of moving contacts. The range of

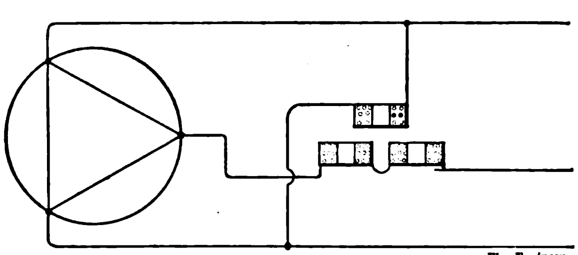


FIG. 3.—DIAGRAM OF 3-PHASE INTEGRATING METER.

accurate working is large, owing to the lightness of the moving parts and small friction in comparison to the forces at work, so that one per cent., or less, of the maximum capacity is measured with accuracy. The speed at full load is low, not exceeding about 40 to 50 turns per minute at full load. The lightness of the disc, the slow speed and the use of the form of lower bearing invented by Mr. Shallenberger in connection with his former meter all contribute to render the friction very slight.

This meter may be used in connection with three-phase as well as with two-phase currents. Fig. 3 shows the three-phase connection in a simple form. The shunt coil is connected across two branches of the circuit and the series coil in the third branch, so that as in the former case the current in the shunt coil is in quadrature with the electromotive force of the series circuit, although the currents in the three branches differ by 120 degrees. The resistance in the shunt circuit having been adjusted to suit the new conditions so as to have a correct constant, the operation is exactly as in the former case.

For greater accuracy, two or more of the branches of a multiphase circuit are connected to corresponding series coils in the meter, and the shunt coils properly related to each, but for commercial purposes the single form is quite accurate enough when used on balanced circuits as in the case of a multiphase motor.

The form of watt indicator shown in Fig. 5, and with case removed in Fig. 6, has been specially designed for the Niagara Falls installation. It is known as the "Niagara

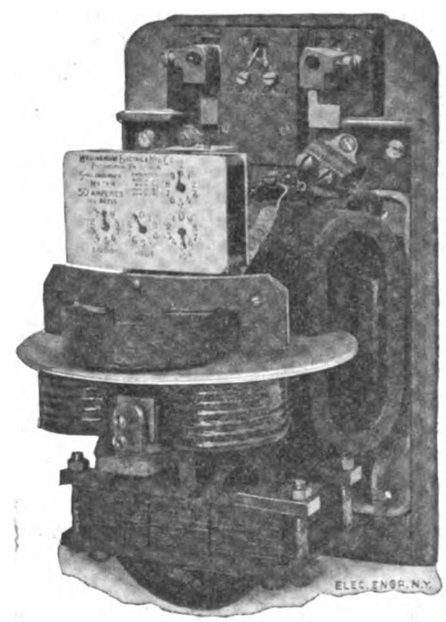


FIG. 4.—SHALLENBERGER SINGLE PHASE INTEGRATING METER.

Type" and corresponds in design with the voltmeter and amperemeter. In these instruments the scale is in the form of a band which encircles the disc and moves with the latter behind a fixed index. This arrangement allows the use of a long scale with large divisions so as to be easily read at a distance. The operation is the same as that of the integrating wattmeter, except that the rotation of the disc is, in this case, opposed by a spiral spring, the magnets acting simply to damp the oscillations. The damping action is so effective that the instrument is almost perfectly dead beat. Adjustments for the zero point and for temperature may be made from the front of the case.

In the voltmeter the two sets of coils are connected in series with a non-inductive and an inductive resistance, respectively, the latter being of a form designed to cause a lag of nearly 90 degrees in its current. For this purpose the iron and copper losses of the inductive resistance are reduced to a minimum and a small air gap is introduced into the magnetic circuit, so as to avoid high magnetization of the core and render the magnetizing current proportional to the induction. The current through this circuit is therefore directly proportional to the difference of potential, and this is of course true in the circuit containing the non-inductive resistance. The deflection is proportional to the

square of the potential, and is also practically independent of the periodicity within the range now generally used, for reasons which will be referred to later. The amperemeter is a modification of the voltmeter, the windings being adapted for larger current and low potential.

In using these instruments at Niagara Falls, transformers specially designed for the purpose will be used to reduce the current and potential to convenient quantities. These transformers are proportioned so as not to introduce errors from change of phase and they avoid the difficulty of constructing and connecting instruments for heavy currents.

Fig. 4 shows an integrating meter for single phase currents similar in its general features to the multiphase meter, except that instead of a non-inductive resistance a coil of high self induction is used in the shunt circuit, of the same construction as that used in the voltmeter. Owing to the extremely high ratio of self induction to resistance in this coil, the shunt current lags nearly 90 degrees, giving practically the phase relations of the multiphase instrument. It therefore correctly takes account of the power factor within the limits found in practice. The design of the inductance coil is a most important feature of this meter since it must not only consume an almost inappreciable amount of energy in order to secure a sufficient lag, but must introduce no distortion of wave form due to hysteresis such as is present in the primary current of a transformer without load.

Important features in this instrument are the use of an air-gap of the right proportion, and a core of a high grade of iron. The iron losses are so small, however, that even if increased by "fatigue" after long use, the lag would remain practically unchanged, and owing to the large angle of lag, the change in the value of its sine, upon which the torque depends, would be still less. Owing, however, to the low induction in the iron, and, entire absence of appreciable heating, it is almost impossible that any change should occur in the iron. The reluctance of the magnetic circuit of this coil is so nearly that of the air gap that the inductance coefficient is very nearly constant, so much so, that the same meter may be used on either 50 volt or 110 volt circuits with an error of less than one

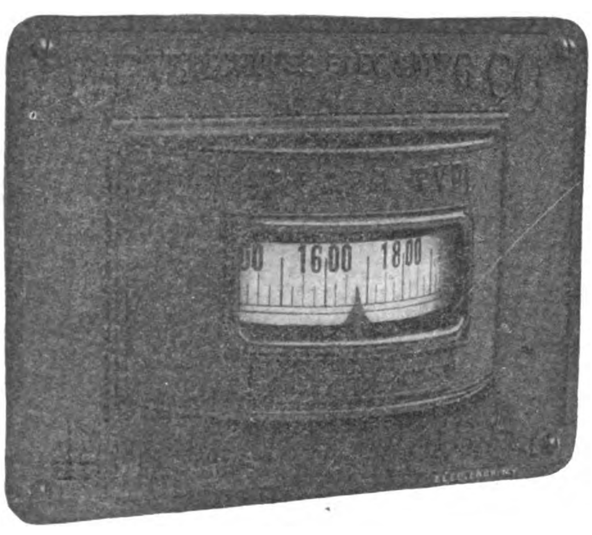


FIG. 5.—SHALLENBERGER INDICATING WATTMETER.

per cent. in the registration. In this form of meter the proportions are such that for given currents and difference of phase in the actuating coils, the torque is directly proportional to the periodicity over the entire range now in use or proposed. Owing to the fact that the inductance coefficient in the shunt circuit is constant, the shunt current is inversely proportional to the periodicity for a given difference of potential. The result of these two laws of operation is evidently that the torque, and consequently the speed, is independent of periodicity. This is proved experimentally to be the case to a remarkable degree. Variations in wave form have no effect within ordinary limits, the constant being the same on circuits supplied from dynamos of radically different types.

One of the most valuable features of this type of meter is its extremely long range, which is secured without the

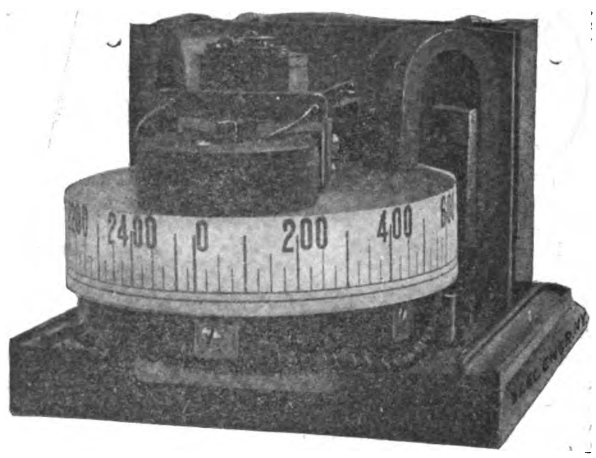


FIG. 6.—SHALLENBERGER INDICATING WATTMETER.

use of any auxiliary winding to overcome starting friction, or any other device giving an initial tendency to rotate. A 50-light meter starts with a load of two 100-volt 16 c. p. lamps in series on a 50 volt current or about two-tenths of an ampere, and at one-half ampere registers with practical accuracy. Continuous rotation is maintained at a speed as low as one turn of the disc in fifteen minutes.

The shunt current is about one-tenth of an ampere as a maximum, and since it is practically a wattless current, the actual energy not exceeding half a watt in ordinary cases, the energy consumed is negligible.

The constant of the instrument is entirely unaffected by changes of temperature, since the retarding eddy currents induced by the permanent magnets are affected by changes of temperature of the disc in exactly the same ratio as those induced by the actuating coils, so that no change in speed results. There is also no temperature coefficient for the shunt circuit, as its resistance is purely inductive.

The purpose in all the experimental work upon these instruments was to secure accurate operation by the simplest forms possible, and the results have been satisfactory in the highest degree.

A PECULIAR CASE OF ERRATIC ELECTRIC LIGHT ENGINE GOVERNING.

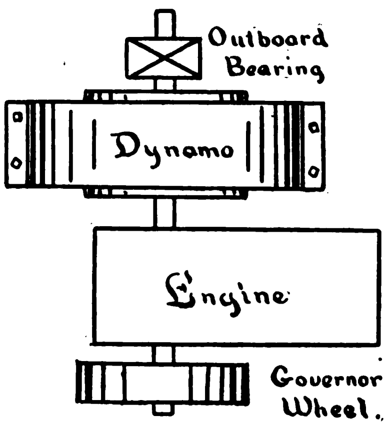
THE time and ingenuity which has been expended in the designing of governors for regulating the speed of electric lighting engines has resulted in a number of very sensitive types. But if all the care bestowed upon them is to be nullified by extraneous conditions not contemplated in their design, much of their value will be lost. A case of this nature was recently brought to our attention which we think merits further inquiry and which we deem of interest to all those operating direct connected engines.

The engine and the dynamo in question are directly connected, and when the plant was installed and started the engine performed in a satisfactory manner both to the purchaser and to the maker's representative. After a time complaints were received because of unsatisfactory regulation; from the character of these complaints it was concluded that there might be some defect in the governor and the manufacturer incurred the expense of sending a

complete new governor, requesting that the old one be returned. The new governor was placed, adjusted and the plant started, and the report came back that the regulation was perfect. In the course of a week or ten days complaints were again entered on the score of unsatisfactory regulation of the governor.

The thought then occurred to the engine builders that possibly the governor was affected by magnetism. They conferred with the makers of the dynamo and were told that in their judgment such could not possibly be the case. The accompanying diagram shows the relative positions of the dynamo and governor wheel.

It has since been learned that a monkey wrench will be



Plan of Direct Connected Dynamo.

held fast to the rim of the governor wheel when the engine is under full speed; the speed of the periphery of this wheel is about 5,400 feet per minute. When the engine is in service the force is sufficiently strong to pull a man, standing at the front or crank end with a wrench held out within two feet, into the engine. Any magnetic substance, such as iron or steel, if placed on the throttle valve wheel is held firmly. The distance between the centre of the dynamo and the eccentric is about 48 inches.

The question therefore arises whether the governor can be affected by the stray magnetism of the dynamo, and whether such a condition in a plant as indicated above may not materially affect the cost of light.

CONDUIT WIRING.

BY

Augustus Noll

In The Electrical Engineer, under date of December 16, 1891, was published an article written by me, under the same title as above, in which I expressed myself as being strongly opposed to the use of two wires in the same tube. Since that time there has been a vast improvement in the art of wiring, and as one must change his views in accordance with conditions, I therefore take this opportunity of referring to some of the statements made therein and of modifying them in accordance with the state of the art.

With the advent of insulated iron conduits the entire conditions have changed. We now have a system of conduits, the materials of which will admit of rough usage, the joints and connections are rigid and permanent, and it is now possible to install a system of conduits which will be *gas and water tight.* While the system of brass covered conduits was a great improvement on the older methods, still it was an expedient, and the legitimate, logical outcome is the present iron armored conduit system.

By the use of iron conduits great advantages are gained. *First*, it procures for us, electrical engineers, a standing in the building trades, for the reason that, the materials being rigid and the elbows and joints threaded so that a hard joint can be made, it compels the architects to provide the necessary channels in buildings, in a manner similar to those for steam and gas fitters and plumbers. In the old method, the joints were what are known as soft joints, being made by crimpers, and even though there was 50 pounds pressure on the crimpers when forcing on the joint, still one ounce of side tension would loosen the joint, on account of the thin material which was used. To-day, on the other hand, the joints on the iron conduit system can be made by means of threads and should be leaded in the same manner as for steam and gas pipes.

Second, the iron armored tubing is a safeguard against nails and other interferences on the part of other mechanics in the buildings.

Third, the system can be used for the alternating current as well as the direct current system.

If proper attention is given to minor details, such as entrance to cut-out cabinets, switch boxes, and at outlets, such as sealing all the ends of tubing, etc., then there is no reason why the electric wiring system will not be as permanent a part of the building as other works.

The Board of Fire Underwriters now allow two wires of opposite polarity in the same conduit, provided the conduit is of the iron armored pattern. I have fitted various buildings with the iron armored tubing, keeping myself advised on all the details, and the result is that I firmly believe that the iron conduit system, with two wires in a tube, is better than anything attempted heretofore. Regarding the wire, the Board of Fire Underwriters allow two "single wires," or a "twin wire" of approved insulation, to be used. I believe that the "twin conductor," or, two wires under the same insulation, is better practice than two "single wires," as in the event of electrolytic action and the forming of an arc, the arc will carbonize the insulating material between the two conductors in a shorter time than if they were separated, and the result would be that the plug would fuse, throwing that circuit out as inoperative in less time. The best insulation should be used, the wires should be thoroughly tinned, and if a covering of cotton were placed next to the wire it would prevent oxidation and disintegration of the rubber to a great extent.

One of the greatest advantages of the iron conduit system is that it has two systems of insulation, one being the insulating conduit inside of the iron tube, and the other being the insulation directly on the wire. Should the insulation on the wire become defective, we can depend on the insulated tube until such time as the necessary repairs can be made, and *vice versa*.

The recent improvements in the art of wiring and insulation make it possible to provide a system that will afford very little chance of interruption to the lighting system, and one that is permanent, fully meeting the views of the Board of Fire Underwriters, and providing safeguards against all probable chances of fire, leaks, etc.

LORD KELVIN AND A NEW PRIMARY BATTERY.

The following item from the New York *Sun's* cable dispatch of Dec. 23, should be taken with a ton of salt:—"According to the Glasgow newspapers two young Scottish workmen, sons of a mechanic employed in the Singer sewing machine works on the Clyde, have invented a battery which, it is asserted, will revolutionize electricial work, and a great man of science like Lord Kelvin thinks so much of it that he offered to buy the patent rights for $50,000. The inventors, aged 21 and 18 years, have, it is said, made a primary battery 'in which, while the decomposition of the zinc plates is rendered enormously slower, and the chemicals used are of trivial value, the strength of the battery thus formed is very greatly increased.' The battery has been put to some severe tests, and is said to have stood them triumphantly. It is evident that these lads have made some sort of a discovery which is likely to bring them fortune, but general expert opinion discredits the idea of an electrical revolution."

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIX. NEW YORK, JANUARY 2, 1895. No. 348.

CONTENTS.

RETROSPECT AND PROSPECT.

THE year that marks the fiftieth anniversary of the beginning of the telegraph, ought to be a good point from which to cast a retrospective glance at the achievements during that period. Such a retrospect would show a gradual dawn, extending over a period of about 30 years, and a late brightening out into a brilliant series of discoveries and inventions, which have for the last 20 years claimed the attention of the whole word. So much original work of the highest order has been done prior to 1894 that the twelve months just past cannot be said to have added very much to the general result; and this is probably due to the reflex action which the the conditions of trade and finance generally have upon scientific research as well as upon industrial enterprises. Electric power transmission in its various forms may still lay claim to the greatest advance among electrical applications, for the year. During that time the great Niagara undertaking has been brought down to the end of its formative period and may now be said to enter upon its commercial existence. The adoption of the two-phase alternating system for this purpose must also be considered as something in the nature of an epoch-making event. Nevertheless, we note during the past year what must be considered the first real beginnings of three-phase work in the United States, which thus adds another to our resources for electrical transmission. Electric railroading, in spite of the financial depression, has taken another decided bound forward, and the equipment of the Chicago elevated roads with electricity must be considered a decided triumph for the electric system of propulsion, which will not fail to have its effect in other quarters. The past has been a busy year in electric lighting in several respects. More than ever have investigators been devoting their attention to the production of the light without heat. The results published are sufficiently encouraging in this respect, while those that are still to see the light of day may soon bring us close to the much desired commercial lamp of this type. Closely related with this subject is the oscillator, upon which Mr. Tesla has been steadily at work, and which he hopes shortly to bring into commercial use. The laying of two new Atlantic cables, larger than those heretofore attempted, is well worthy of special mention, as are also the active steps taken towards the putting down of a Pacific cable, the accomplishment of which will complete the encircling of the globe. But though the year past exhibits few prominent features in the domain of scientific and technical progress, the electric litigation of 1894 in the United States will always stand out as among the most prominent in the annals of electric jurisprudence. It was especially disastrous to patents and we need only note the decisions annulling the Berliner transmitter, the Field railway, and the Edison "feeder and main" patents to recall the widespread influence of the action of the courts in the electrical field. To these must be added the cessation of the prolonged storage battery litigation, which gives ground for hope that we may now see some good and solid work in this field done in this country, where the opportunities, though perhaps greater than in any other country on the face of the earth, have been almost entirely neglected. Fortunately the past year has deprived us of but few valuable workers, though the loss of Hertz was a heavy one, and the world can ill afford to spare men of his noble type. If the indications of the past few weeks are a criterion, the pro-

spects for the new year are of a decidedly cheerful nature. With the revival in trade will come revival in experiment and invention, and the improvements which follow therefrom, which have made the electrical arts the most progressive of the time.

CULM PILE AND PEAT BOG UTILIZATION.

That the huge culm piles of Central Pennsylvania will soon be utilized seems likely, as it is proposed to put up a plant for electrical power transmission somewhere in the vicinity of Wilkesbarre and Scranton, the long valley between which is simply filled up with the work of the mound builders of these industrial times. Details of the scheme are indefinite as to the amount of culm available, the size of the plant and the distance of transmission, but if the plans of the promoters are moderate there is no reason why the scheme should not succeed. In other words, it is better to try the plan over some short range of distribution rather than make the plunge all at once into an enterprise involving distances of over a hundred miles. In this respect, electrical engineers must certainly creep before they can walk, and the lesson of Lauffen needs the confirmatory demonstration at Niagara.

Still, all these schemes are in the right direction, and deserve as much encouragement as can be given them. We ventured to suggest last July that it would be well to make electrical power transmission from coal mines one of the features of the Paris Exposition of 1900, and we hope to see a large experiment of the kind carried out then and there. It will be remembered also that in England, Messrs. Thwaite & Swinburne have proposed to send the energy of the Midland coal fields up to London by wire instead of rail, and have figured on a cost of £340,000 to cover every item of a 10,000 H. P. transmission for 100 miles. The outlay to-day would probably be much less than when they figured. The price of electrical apparatus is much lower, and though it will recover to some extent, it will never get back to the old scale. When Messrs. Houston & Kennelly presented in these columns their remarkable calculations, which attracted worldwide attention, as to the cost of transmitting the energy of Niagara to Buffalo, Rochester, Albany and other cities, one of the strongest and most frequent criticisms was to the effect that they had gravely underestimated the cost of the apparatus. We have the best grounds for saying that so far from assuming figures that were too low, they were on the safe side in every item, and could have gone lower, without error of any kind. In short, all the conditions run steadily in favor of power transmission enterprises, and will continue so to do indefinitely.

As an evidence of the manner in which schemes for fuel economy and power transmission have seized upon the mind of the present generation, we may refer to the proposal to utilize peat bogs in this way. The best treatment of this interesting proposition will be found in an article that appears in a recent *Nineteenth Century*, by Mr. J. Munro, who points out that much might be done for Ireland and Scotland by burning peat for power purposes and by the manufacture of a number of byproducts from it. The possibilities in this direction are really remarkable. As the value of raw peat is about 1 to 6 as compared with good coal, the 2,830,000 acres in Ireland alone, equivalent to 470,000,000 tons of coal at about $3 a ton, represent £280,000,000 sterling. In the whole of the United Kingdom there are no fewer than six million acres of peat of an average depth of 12 feet; and the deposits have a rapid rate of growth. In the northern part of Europe, large use is made of such fuel, the consumption in little Holland being 280,000 tons per annum, while in Sweden some 30,000 tons a year are used in metallurgical operations. In Ireland and Scotland, there is great need of light railways for handling sea food, vegetables, &c., where heavy standard gauge construction would not pay; and if nothing else were done with peat fuel, it would seem possible to employ some of it in the operation of such roads and the driving of such factories as might spring up near them.

MULTIPHASE ALTERNATING METERS.

Multiphase alternating work has served to call forth a number of auxiliary apparatuses adapted for this type of distribution, but thus far the indicating and recording instruments have not received special attention. This is particularly the case with regard to the energy indicators and wattmeters, which is perhaps due to the fact that they present difficulties not encountered to the same degree in the single phase systems of distribution. Where the angle of lag has to be taken into account and where the wattless current must be considered, it is evident that the ordinary types of meters are practically useless. We are therefore glad to present to our readers the description of a series of indicating and recording instruments, designed by Mr. O. B. Shallenberger, the pioneer in alternating meters, in which these phenomena have been duly considered. The appearance of these meters is another indication of the fact that the multiphase current has come to stay, and we may add that the distribution at Niagara, for which these instruments have been specially designed, will prove to be the source of not a few innovations and progressive departures in alternating methods and apparatus.

INFLUENCE OF MAGNETISM ON ENGINES.

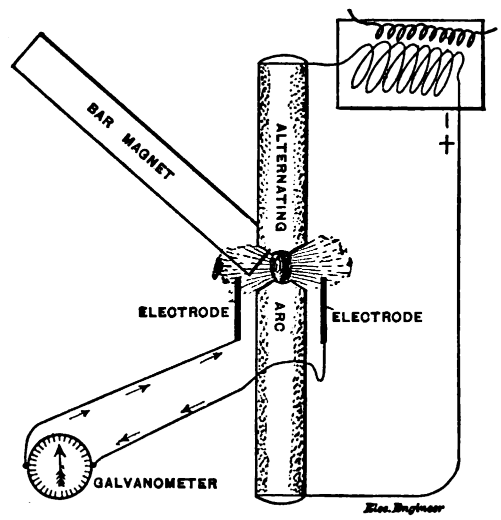
We present in another column the history of an interesting case of erratic engine governing, in an engine direct-connected to a dynamo. The case is one which is well worthy of study as the cause put forward to account for the observed action may exist in instances where it has heretofore not been suspected. It must be admitted that, taking into consideration the relative positions of the governor and the dynamo, it is strange that the latter should be so strongly affected by magnetism, but the undoubted magnetic properties which the governor possesses give strong grounds for belief that the disturbances noted may be due to magnetic action. It can well be conceived that, with forces acting on the governor ball and springs other than those designed to be called into action, irregularities will result. Taking such a case to be well authenticated, it would be an interesting study to devise means to nullify or obviate the effects shown to exist. Such an investigation might also include the effects of the added friction in the piston, valves and other iron surfaces in sliding contact about the engine, due to magnetic adhesion between the moving parts. It may be argued with much force, of course, that in a well designed dynamo no stray magnetism capable of showing such effects ought to exist, but the fact nevertheless remains that dynamos frequently do show marked external magnetic characteristics, and hence the inquiry may not be quite so futile after all. We will be glad to learn whether the experience of our readers has brought to light any disturbing effects in engines due to magnetic causes.

CONTINUOUS CURRENT FROM THE ALTERNATING ARC.

BY

R. J. Feather

WHILE doing some experimental work recently I placed the end of an ordinary bar magnet near an alternating arc and found that it repelled the arc in such a manner as to make a flame on both sides of the magnet, and upon putting a pair of electrodes, connected with an ordinary galvanometer into the two flames, I obtained a unidirectional current; upon reversing the electrodes in the arc flames it also reversed the current flowing through the galvanometer. This forms a very novel "commutator" for obtaining direct from alternating current, though hardly of any practical use. The accompanying diagram will serve to illustrate the experiment. Perhaps some of your readers can explain the action noted.



CONTINUOUS CURRENT FROM THE ALTERNATING ARC.

ELECTRICAL MACHINIST PRACTICE.—XVI.

BY

James F. Hobart

As stated in the last paper, an armature balanced by weights placed diametrically, but not axially, opposite each other, will have a tendency when running, to create a new axis the direction of which will be a resultant of the forces represented by the action of the several counter weights and heavy places in the armature. When there is a combination of heavy and light places in an armature, the formula $p = \frac{W V^2}{g r}$, will demonstrate that the counter weights need be slightly different in weight for various speeds, thus showing that armatures ought always to be put in *running* balance for, and at the speed at which they are to run. Balancing in the ordinary manner upon straight edges, cannot give a running balance; therefore some other method must be employed. Before attempting to describe a practicable method of putting an armature into perfect running balance, I wish to say a few words concerning the present methods, of which two are used chiefly.

One method, and a very good one too, as far as it goes, is to add solder enough to the binding wire, to make up the weight of the heavy spots. The other way is, as described in Paper XV., to bind pieces of lead into the space between commutator and armature. This is bad practice, although often done in regular armature repair shops, as shown in the paper mentioned.

There is a constant tendency towards getting loose on the part of the lead counter weight, as it must be bound tightly upon the armature connections to the commutator, a foundation that is very yielding at best, and constantly changing shape under pressure.

The armature should be carefully tested before the wire is put on as there is much difference in the density of even different parts of the same piece of iron, and when the density varies, the weight also changes. If an armature is balanced to a running balance, before it is wound and not to a mere standing balance, it will be found to be very nearly in balance after the winding is put on.

In order to secure a running balance, the armature must be mounted in flexible bearings and made to revolve at the stated speed, without any tendency on the part of the axis to form a new axis. In plain English, the shaft must be "hung in the air" and so balanced that it will not wobble. We cannot well suspend an armature in the atmosphere; therefore, some substitute must be used, which will approach very nearly to the requirements.

A spiral spring comes very close to filling the conditions. To neutralize the weight of the armature as much as possible, it may be mounted vertically so the weight may be borne as a thrust axially, instead of radially. Such a machine is shown[1] in the engraving, Fig. 74. A pair of spindles are provided, *a* and *b*, only one of which need be "alive," although it may be better if both are driven by power. Chucks, *c* and *c'*, on the spindles are fitted with spiral springs *d* and *d'*. For different sizes of armatures it will be necessary to change these springs, but one size, say of ⅜-inch steel wire, springs 6 inches long, will handle armatures from four to eight inches in diameter. Three sizes of springs, with attached chucks *c c'*, and shell chucks *e e'*, will probably meet all requirements in ordinary construction and repair shops. For large multipolar armatures, several feet in diameter, other apparatus must be designed, but the comparatively slow speed at which such armatures revolve, makes easier the problem of balancing them.

The armature shaft is gripped at either end by the shell chucks *e* and *e*.' Probably some other form of chuck, possibly a small, three-jaw universal, will be used instead of the old fashioned device shown, but, intending to show the cheapest form of "home made" tool construction, the shell chuck is pictured, and shown in plan, at *k*.

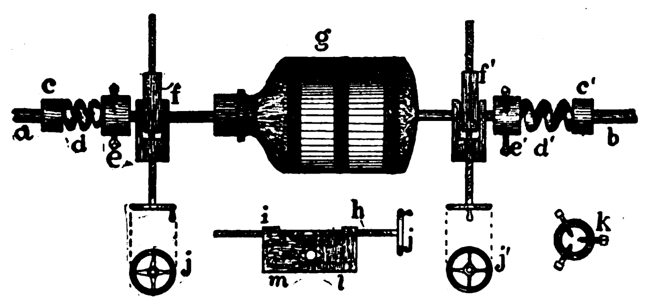


FIG. 74.

The armature *g*, is put into the chucks, and the guides *f*, *f'* are applied as shown. These guides are shown in plan, at *l*, *m*, the screw *h*, and hand wheel *j*, operating the jaws *l* and *m*, which are attached by nuts formed in the projecting lugs, one being indicated by *i*. As soon as the armature is put up, and the chucks *e e'* carefully centered upon the armature shaft, the guides are set carefully up against the shaft, and the machine started up. When up to speed (if the balance of the armature will allow it to go up,) one of the guides is stacked a little by unscrewing the

1. The device is shown in horizontal position for the sake of convenience. EDS. E. E.

right and left screw which is attached to hand wheel *j* or *j'*. This allows that end of the armature shaft to be supported entirely by the spring (which is shown rather out of proportion in the engraving), and if anything about the armature is out of balance the gyroscopic action of the armature shaft, as it seeks to establish a new axis, will very quickly tell the story, and show where the counterweight must be attached.

The counterweighting of the armature must be so arranged that it will run steadily, without shaking, fully up to speed with both guides entirely removed from contact with the shaft. When it will do this, and not until then, is the armature in perfect running balance and fit to be sent out of the shop.

It will be noticed that the jaws *l* and *m* may be made to fit almost any size of armature shaft by simply screwing them together or apart. It is understood that the guides *f* and *f'* travel upon rigid ways, like the cross feed of a lathe. In fact a lathe bed set in a vertical position, answers nicely for this machine to be built upon. The slide rest may be made the foundation of one of the guides, and another rest may be added to carry the remaining guide. It is very necessary that the guide be made of considerable strength and very stiff, for, when an armature badly out of balance is put into the machine, the shaking will be something frightful to the inexperienced man, and the guides must be stiff enough to hold things beyond even a possibility of giving way. It is well then, to screw back the guides very carefully and gradually, until it is certain that a good balance has been secured.

ELECTRIC TRANSPORTATION DEPARTMENT.

NEW HAVEN'S ELECTRIC RAILWAY SYSTEM.

The street railways of New Haven are now equipped with electricity with one exception and that one road is soon to abandon horses and adopt electricity.

The West Haven road, now under the control of the Winchester Avenue Company, was the pioneer in the introduction of electricity which it adopted in August, 1892. The New Haven Street Railway Company, including the State Street and Whitney avenue lines and their extensions have been using electricity since last spring and the Edgewood Avenue road, which is now under the same management, has been using that system since the line was opened. The Fair Haven electric power house has finally

New Haven's Electric Railway System.

been completed and cars are now running on that line. The Centerville road will before long be in operation.

With the introduction of the trolley system has come also the extension of the various lines in different directions and the introduction of important economies in the practical management of the roads. In regard to the matter of extension, it is noticed that the roads are already in possession of 28 miles of streets within the city limits. This is more than one-fifth of the total mileage of streets in the city, there being about 130 miles of streets in the city all told. Charters have already been granted for 13 miles of streets in addition to those already in use, and in some cases the track has already been laid but has not been operated as yet. When the streets for which franchises have already been given have all been occupied there will be 41 miles of streets given over to the street railway companies, or nearly one-third of the total street mileage of the city. On the accompanying map the black lines indicate the streets already occupied by street railroads. The dotted lines represent streets for which street railroads have asked and permission has been given by the legislature.

THE THREE-WIRE TROLLEY SYSTEM AT ST. LOUIS, MO. AND BELLEVILLE, ILL.

BY W. C. GOTSHALL.

At the last street railway convention the General Elec. Co. formally presented to the public their three-wire system, which they had been perfecting for some time. In the early part of October I commenced installing the three-wire system on the Union Depot R. R. Co.'s system, of St. Louis, Mo., and before the General Elec. Co., had introduced it to the public we were operating under it. We have now been operating for some time on the three-wire system. We have our farthest and heaviest section on this system. It is on our down-town section and in a locality where we cross six other roads, and have twelve overhead crossings to contend with and some of them double crossings.

On one part of this section we occupy joint track with another road but use separate trolley wires. The two wires are within 12 inches of each other and cross each other twice. At first numerous difficulties were encountered but they have all been overcome. Some very interesting results have been obtained and the company is delighted with the showing.

The voltage on this section was formerly very low in the morning and evening. It is now all that could be desired. The lamps burn brightly and we are enabled to make better time and run more cars. There are many crossings and switches on this section even excepting those of other companies and altogether its success in this instance is very gratifying.

As the Union Depot Co., operate some 250 cars the importance of its success to this company can readily be seen. The experimental work has all been carried on with D 62 machines. Preparations are now being made to establish it permanently and change the rest of the system. I trust that this information may be of interest as indicating and recording another successful step in the direction of economy in the use of power and copper on street railway circuits.

SPECIAL TROLLEY MAIL DELIVERY IN PITTSBURGH.

Col. Craige, the third assistant postmaster-general, is much gratified at the news he has received from Pittsburgh, Pa., that the street-railway companies of that city have all allowed the special-delivery messengers from the local post office to ride over their lines without paying fare, if engaged in delivering letters. This is similar to an accommodation offered by the street-railway companies of New Orleans several years ago, and gladly accepted by the government. It is hoped that the disposition will prove contagious, and in all the good-sized cities of the United States something of the sort may be done. The fee the government is able to charge for the special delivery of a letter is too small to admit of paying much to the messengers, and when long distances have to be traversed in cities where bicycling is difficult or dangerous, a messenger must walk one way or spend on fares more than he receives, unless he happens to have two letters at a time to be delivered at points close to each other. It is understood that the government puts itself under no obligations for these accommodations, the car companies believing it good policy to do as much as this for the public convenience.

PUBLIC LOATHING OF THE DEADLY TROLLEY.

The new trolley line has been started at Kingston, N. Y. The local *Leader* says: "It was expected that there would be some slight demonstration of popular approval when the car passed through Wall street, this fact being indicated by the request of a number of Wall street merchants that they be allowed to place a brass band on board, but nobody for an instant suspected that it would meet with such an ovation as it did. From the starting point on Cedar street to the end of the line at the corner of Washington and Linderman avenues, the entire populace all along the line turned out to bid it welcome. There was scarcely a house that was not illuminated from cellar to garret and hundreds of blazing barrels, boxes and almost anything that would burn, aided in adding brilliancy to the scene, while red fire torches, Roman candles and other fireworks hissed and sputtered, flashed and glittered."

BINGHAMTON AND STATE LINE ROAD.

The Binghamton and State Line Railroad Company, which has begun the construction of a road to connect Binghamton and Williamsport, Penn., is experiencing considerable difficulty in securing the right of way over the proposed route on account of the exorbitant figures demanded by property owners. The line as surveyed is exceedingly tortuous, owing to the roughness of the country which it traverses. The projectors of the road are now considering the advisability of using electricity instead of steam as a motive power, as an electric line could be operated on much steeper grades, and the distance thus considerably shortened. If the project is carried out, the new road will be the first railway of any length to be operated by electricity, and Binghamton, which was the first city in the State to operate an electric street railway, will soon gain the honor of being the pioneer in the long-distance movement.

THE LOW FARE WAR IN SAVANNAH, GA.

The Savannah electric railway company has increased the fare on one of its lines from 1 to 2 cents, and on another from 1 to 5 cents. The reason for the increase given is that the regular patrons of the lines demanded it on account of the inconvenience suffered by the overcrowded condition of the cars at the 1 cent fare. Fares on the other lines throughout the city continue at 1 cent.

PHILADELPHIA ELECTRIC POLICE LAUNCH.

The immediate and constant readiness for work of the electric launch makes it not only the ideal craft for pleasure purposes subject to the caprice and humor of its owner, but gives it a special value for the sterner realities of life where constant readiness for actual duty is necessary. The most recent application of this kind is exemplified in the electric launch just put in service by the Police Department of Philadelphia.

The launch which is illustrated in the accompanying engraving, has the following dimensions: Length over all, 25 ft.; breadth of beam, 5 ft. 6 in.; draught, 2 ft. 8 in.; freeboard, 1 ft. 2 in.

The hull is framed of white oak planked with white cedar and copper fastened. The finishings are of oak and ash with high combing of oak. Above the water line the boat is painted white, and copper brown paint below the water line; all the upper works are varnished in the natural wood.

The motor is directly connected to the propeller shaft and placed beneath the flooring in a lead lined compartment. All bearings are self lubricating and are noiseless, the thrust of the propeller being taken up by ball-bearings.

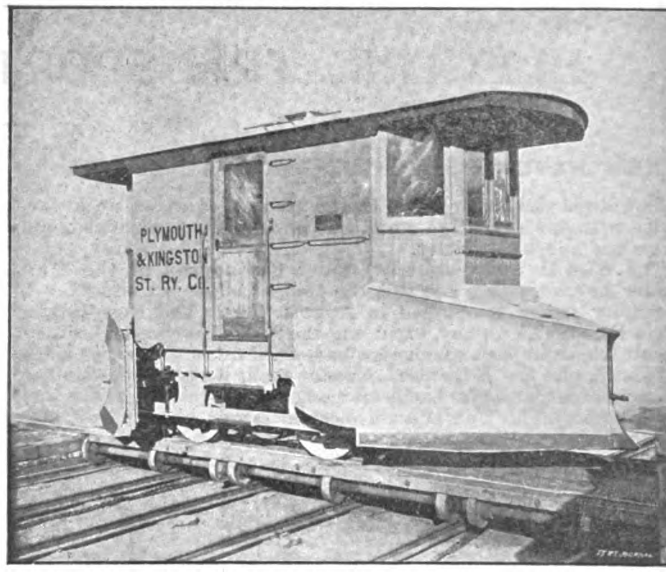
Forty storage batteries are placed under the seats and flooring. The batteries are of the chloride type manufactured by the Electric Storage Battery Company, of Philadelphia. The batteries and motor are connected with a controller operated near the steering wheel.

PHILADELPHIA ELECTRIC POLICE LAUNCH.

Various speeds can be developed up to a maximum spurting rate of nearly 8 miles per hour and the duration of a run without recharging depends upon the speed developed or power used in service. The recharging of the batteries will be done from the electric plant on board any one of the fire or police boats; the current will be of about 95 volts and 15 to 20 amperes, and the complete recharging will be effected in from 4 to 6 hours. We are indebted to Mr. J. C. Chamberlain, E. E., for the above interesting details; the launch having been built under his supervision at Morris Dock, N. Y.

TAUNTON ELECTRIC SNOW PLOW.

Thus far electric railways have generally imitated their predecessors, the horse railways, by using large sweepers with revolving brushes to clear their tracks. While this is undoubtedly the best practice in city streets where the track must be kept cleaner



TAUNTON ELECTRIC SNOW PLOW.

than can be done by any plow or scraper, there is now a large mileage of electric railways in suburban and county districts operated under conditions approximating more nearly to those of steam railway practice, and for these the plow built by the Taunton Locomotive Mfg. Co., of Taunton, Mass., and illustrated in the accompanying engraving is especially adapted. It consists essentially of a four-wheel car with a nose plow and adjustable wings at each end, so that it can be run equally well in either direction. The operating levers are within the car, leaving a clear floor space of 6 x 17 ft. The weight of one plow is balanced by that of the other, so that not only is the load on the wheels evenly distributed, but the operator in lifting the plow has only to overcome the friction of the mechanism. The plows are raised by a parallel motion and so rise squarely from the track, the rear plow having a clearance of 8½ ins. above the rail. There is ample room for the electric motors, the lifting apparatus being only at the ends. Each side wing is operated by an independent lever. The digger mechanism is thrown down by a kick of the foot, and may be raised instantly by one hand by throwing the lever a short distance. The digger iron is held to its work by a flat spring, which is strong enough to cut away ice and snow, but will yield enough to give way if the digger strikes the end of the rail, a switch or a frog. A sand or salt spout is provided for each wheel. The leverage of the brakes is such that 25 lbs. on the brake handle applies a pressure of 1,000 lbs. on each brake shoe. The working mechanism of all parts is located at each end of the car and the body of the car left free for salt, sand and men. The beveled shape of the ends, with the sliding windows, gives an opportunity for looking forward or back and there is no necessity for going outside of the house to do or to see anything. Any size of wheel can be used, but the preferable size is 33 ins., with ⅞-in flange. The wheel base is 6 ft. 6 ins. The plow weighs, when ready for the motors, seven tons. It is strongly built, as may be seen by the statement that it carries over three tons of castings and a ton of forgings. The design for this plow was prepared in the office of Dean & Main, Boston, Mass., under the direction of Mr. F. W. Dean, M. Am. Soc. M. E.

These plows are especially adapted for heavy cross-country or suburban single-track roads, and about twelve have already been sold. A plow of a somewhat lighter design for use in and about city streets is being built for use at Fall River, Mass.

SYNDICATING A NUMBER OF NEW ENGLAND ROADS.

It is proposed to form a single corporation of the Globe Street Railway company of Fall River, Mass., the "Gee Whizz," which links Fall River to New Bedford, the Union Street Railway company of New Bedford and the Taunton Street Railway company. As a matter of fact the electric lines mentioned are at present controlled by a syndicate which will be at the head of affairs when the organization contemplated is completed. The prime mover is Frank S. Stevens, of Swansea, aided by Robert S. Goff. Frank Brightman, treasurer of the Stafford mills, is regarded as a silent partner. Back of Mr. Stevens and his associates, are the Kimballs of Rochester, N. Y., who have millions invested in the cigarette trust; Mr. Beckley, the well known street railway manager, of the same city, and a number of capitalists scattered over the country.

As stated, this combination holds the balance of power in all of the electric lines in these parts. It now means to gather up all the loose ends and unite under a common head.

The consolidated company will then be in a position to branch out. It will lay tracks to Tiverton and possibly to Newport, also to Providence via the shore resorts and likewise to Taunton.

THE TROLLEY ROAD BETWEEN BALTIMORE AND ANNAPOLIS.

The Baltimore, Severn Park & Annapolis Railroad Co., will begin construction work about January 1. The road, which is twenty-eight miles long, is to connect with the Annapolis & Bay Ridge electric line, on which work is to begin about the same time. The Baltimore road will be single track, 80-pound steel rail. It will enter Baltimore through Westport, connecting with the Baltimore Traction Co.'s system. The power house is to be located at Severn Park. The company intends making fast time and catering to the regular Annapolis traffic, while it expects to make a business of hauling fruit and vegetables from Anne Arundel county to the local market, and to a wharf it intends building 200 feet long on the harbor, where the freight can be loaded on steamers for the North. The cost of the line complete is estimated at $400,000. J. C. Musgrove, of Philadelphia, is said, to be president of the company. He is heavily interested in Bay Ridge.

RAPID TRANSIT IN ST. LOUIS.

A special despatch of Dec. 26 from St. Louis, Mo., to the *Evening Post*, says:—St. Louis spent $5,000,000 during 1893-4 in the improvement and extension of its street-car service. There are now but two horse-car lines in the city, and the claim is made that for rapid transit St. Louis is ahead of any other city in the country; certainly no Eastern city is so well equipped. It is interesting to note the effect such a system of rapid transit has had on the traffic. Street-car officials say they never before had so prosperous a year, and that the returns have been far beyond their most sanguine expectations. The fact has been demonstrated that improved facilities cause people to ride more. The figures are not yet completed, but when made up they will show that street-car travel here has increased something like 20 per cent. The ugly feature of what would be otherwise a most gratifying report lies in the fact that accidents have been of very frequent occurrence on the trolley lines, though the assertion is made that even in this particular an improvement is noticeable.

A LARGE TROLLEY NETWORK FOR HAMILTON, CAN.

The contract for building the main line of the Hamilton Radial Co.'s trolley system from Niagara Falls to Shaw Station, on the main line of the Canadian Pacific, has been awarded to Bracey Bros., Chicago, who are building the Toronto, Hamilton & Buffalo. The contract calls for the completion of the line from Hamilton, Ont., to Grimsby, 15 miles, by Jan. 15, and to St. Catharines by Feb. 15, 1895. Over 500 men will be put to work immediately. In the meanwhile the Niagara Central & St. Catharines, between St. Catharines and Niagara Falls, will be placed in first-class condition. The Radial company has decided to build to Shaw Station instead of Guelph Junction, as at first proposed. The company has also modified its request of the city of Hamilton for a bonus of $400,000 to one of $300,000. The Canadian Pacific is said to be back of the scheme.

THE BALTIMORE BELT TUNNEL.

The Maryland Steel Co. has secured the contract for making and erecting the overhead electrical equipment for use in the Baltimore Belt tunnel. The work will cost about $80,000. Instead of using an overhead wire for the circuit, the General Electric Co., which is building the motors to haul Baltimore & Ohio trains through the tunnel, has decided to build an iron trough 1½ ft. in circumference. A flexible wire will be attached to a shoe which will pick up the current. The iron trough will be of heavy workmanship and the work built to support it will be of light iron bridge construction. Iron poles will be placed 30 yards apart for the track inside the tunnel. On these poles will rest a framework of light iron, which in turn will support the trough. In the tunnel the trough will be near the center of the tunnel roof, held in place by iron braces, 30 yards apart, and fastened by bolts to the side of the tunnel arch.

CHANCE FOR AN ELECTRIC ROAD VEHICLE.

Arrangements are completed for a road race, open to all nations, next year, for vehicles propelled by any mechanical power, between Paris and Bordeaux. The sum of $10,000 is already subscribed for prizes. The winner will receive half. Electricity, steam, carbonic acid, and compressed air are among the motive powers to be used.

NO MORE FREE RIDES IN TROY, N. Y.

The Troy City Railway Company, which controls the trolley railway business of Troy, Lansingburg, Waterford, Cohoes, and Green Island, has obtained legal advice as to what constitutes a public official in regard to the giving of free passes over the road. The policemen and firemen, who heretofore rode free, will have to pay fares after Jan. 1. President Cleminshaw and other persons in the City Railway Company intended to make a contract with the officials of the places mentioned to carry firemen and policemen on the cars for a nominal consideration, but were satisfied by counsel that the company would be liable to prosecution.

ELECTRIC RAILROAD SCHEMES IN CONNECTICUT.

The incoming Legislature will be asked to authorize the construction of an extensive electric railway system in New Haven. If pushed through, the new road will cover nearly every important thoroughfare in the city not now given over to railway traffic, and many surrounding towns are to be connected in the proposed system.

In addition to this, the Bridgeport Traction Company, in local announcements, says that it wants to run its road west to Westport, through Fairfield and Southport; also a branch to Parlor Rock and a branch to Stratford, which will cross the new Washington bridge and enter the town of Milford. From the latter point it will run to Sanford's Hotel, in Woodmont, where it will connect with the Winchester avenue road of New Haven.

This would give electric road communication from New Haven Green to Westport, a distance of about thirty miles. Among those interested in these schemes is A. C. Pond of Boston.

THE STATEN ISLAND INTERIOR RAILROAD CO.

Articles of incorporation have been filed by the Staten Island Interior Railroad Company, whose principal office is to be at New Brighton. The company proposes to build and operate a street-surface road, fifteen miles long, in the county of Richmond. The capital stock is $300,000. The directors include Herman Bergholtz, D. F. Van Vleet, F. C. Cornell, and Daniel Thomas of Ithaca, and D. F. Everts of New York.

MORE TROLLEY FOR PHILADELPHIA.

The Philadelphia Traction Co. is to put on six new lines of trolley this winter. They include the Continental, Columbia Avenue, Spring Garden and Wallace Streets and York and Dorphin Streets, two West Philadelphia branches and a new road.

MILWAUKEE, WIS.—Three cent trolley car fares are being agitated, and it is proposed to make that the rate at least for those who have to stand up.

PERSONAL.

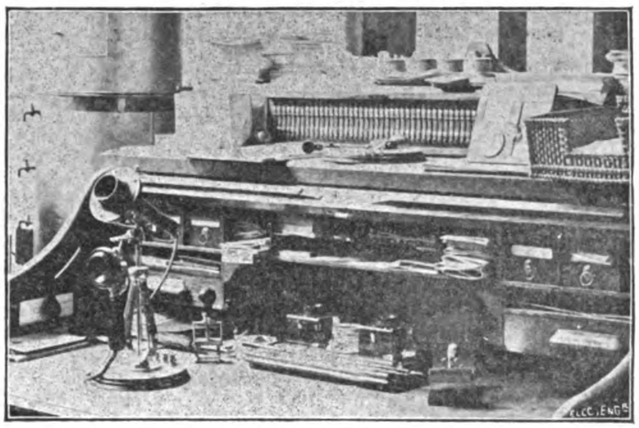
MR. JAMES F. HOBART who is contributing the valuable and interesting series of articles on "Electrical Machinist Practice" to THE ELECTRICAL ENGINEER has been appointed Mechanical Engineer in the Quartermaster's Department U. S. Army, with headquarters in New York.

MR. WALTER PHILLIPS, Electrical Engineer of the Illinois Steel Co., South Chicago, has just completed an extensive trip through the East investigating the various applications of electric power transmission to rolling mill work, with a view to its extensive introduction into some of the mills of the Illinois Steel Co.

TELEPHONY.

THE GILLILAND DESK TELEPHONE SET.

The Gilliland Telephone Company, Chicago, one of the first to enter the telephone field after the expiration of the fundamental Bell telephone patents, have recently perfected a desk telephone set and switch to be used in conjunction with their well known private line and exchange apparatus. We give an illustration of such an outfit, the view showing the private desk of the Company's manager, Mr. J. J. Nate, who by the way, designed the set and incorporated in it several entirely new and original features. It can be used with either a magneto or battery calling arrangement. The switch shown on top of the desk is a part of the



GILLILAND DESK TELEPHONE SET.

outfit and can be placed either under the telephone pedestal or at any other convenient place. The switch has as many contact points as are necessary for intercommunication between the several stations and is provided with an ingenious automatic device allowing a call signal to be received, even if the switch lever should not have been returned to its normal position. The switch can of course be also used with their regular wall set. The transmitter used with this set is entirely new in design and is claimed to possess features of merit (both mechanically and electrically) not found in other transmitters of that kind. While the set as shown constitutes their regular high grade desk equipment, the company will also furnish what they call their No. 2 set, in order to supply the demand for a somewhat less elaborate apparatus, which however will contain all the essential features of the higher priced outfit. On top of the desk may also be noticed a 50 wire section of the new Gilliland fusible arrester board.

TELEPHONES FOR THE DETROIT POLICE.

The Detroit Police Board has decided to begin stringing its own metallic circuit telephone wires on five of the main thoroughfares. The local Bell company charges the police $5 per year rental for each trumpet and transmitter in the 250 signal boxes even when the wire used belongs to the city. When asked to give figures on a metallic circuit basis the Bell people required a five years contract at over $10,000 per year for the service to the board to put in the wires, insulators, etc. Now that the Berliner patent has been broken the Police Board feels safe in casting about for a new system, and it is said will select some other than the Bell telephone.

OUTPUT OF AMERICAN BELL TELEPHONES.

The instrument statement of the Bell Telephone Company for the month and year ended Dec. 20 is given below. There was a net otutput of 1784 instruments for the month, and 17,175 for the year. There are 12,245 more instruments in use than there were a year ago. Details follow:

Month Dec 20.	1894.	1893.	Increase.
Shipments	8,472	4,892	3,580
Returned	6,688	6,126	562
Net output	1,784	*1,234	3,018
Fiscal year.	1893 94	1892 93	Increase.
Shipments	89,493	81,418	8,075
Returned	72,318	65,438	6,880
Net output	17,175	15,980	1,195
Instruments in use Dec. 20	592,398	580,123	12,245

*Deficit.

The total of Bell instruments in use Dec. 20, 1894, was 583,666.

LITERATURE.

Proceedings of the International Electrical Congress at Chicago, 1893. The American Institute of Electrical Engineers, New York, 1894. 488 pp., 6 x 9 inches. Cloth. Illus. Price, $3.00.

ALTHOUGH late in making its appearance, the report of the Chicago Electrical Congress constitutes a volume which has a distinct value, not only as a record of what was accomplished at that important meeting, but as a memento of a gathering such as will probably not be brought together for many years to come. The proceedings of the congress have already been so widely published that it is not necessary for us to describe the contents of the report before us, but the collection of the various papers and the reports of committees into one volume, affords a handy means of reference to the work accomplished on that occasion. The American Institute of Electrical Engineers is especially to be commended for having taken up the publication of this volume and much credit is due to the editor, Mr. Max Osterberg, for the faithful manner in which he has carried out the plans of the Publication Committee.

A Laboratory Manual of Physics and Applied Electricity. Arranged and edited by Edward L. Nichols. Vol. II. Senior Courses and Outline of Advanced Work. By George S. Moler, Frederick Bedell, Homer J. Hotchkiss, Charles P. Matthews, and the Editor. New York. Macmillan & Co. 1894. 454 pp. 5½×9 inches. Cloth. Price, $3.25.

THIS is the second volume of the Manual, and is intended to put before the student the proper methods of investigating phenomena in the laboratory, having in view the practical application of those phenomena as embodied in the actual construction of commercial apparatus. The first volume, it will be recalled, consisted of a laboratory course in general physics for beginners, in which the student is guided by minute directions as to the method of manipulation of the apparatus employed and the arrangement of results. In the present volume it has been taken for granted that the student has completed such a course and is preparing himself to take up special work. For those who intend to follow the special course of electrical engineering, this volume will prove of the greatest value. It has been divided into four parts.

Part I, "Experiments with Direct Current Apparatus," begins with the study of a dynamo, passing successively through the determination of the characteristic curves of the series and shunt machine, the armature characteristic, the characteristic of a compound dynamo, and also of the various special types of machines such as the Edison, Waterhouse, Thomson-Houston, and the Ball. The various efficiencies and their method of determination are next taken up with the aid both of transmitting and absorption dynamometers. The calibration of instruments, the determination of the various losses in the dynamo, the determination of the magnetic leakage, and a variety of other experiments, amounting in all to fifty-three, serve to give the student an excellent insight into the methods to be employed in experimenting and in calculating the design for the continuous current dynamo.

Passing to Part II, "Alternating Current Experiments," we find an excellent collection of studies, involving the determination of the various factors in alternate current generation, the measurement of the coefficient of self-induction by various methods, the measurement of alternating current power, the effect of frequency upon impedance of a circuit containing resistance and self-induction, and the measurement of mutual induction. The testing of transformers is also fully treated, four methods being given. The influence of capacities and the various methods for determining and comparing them is also fully gone into, together with the effects of the variation of resistance and capacity in circuits of different types. In many of these experiments the Bedell-Ryan instantaneous contact-maker, described before the American Institute of Electrical Engineers, is used, and presents a most convenient and accurate means for accomplishing the desired object. Experiments to the number of 64 are included in this part of the work, which, considering the activity in alternating current work of all descriptions, gives the book a special value.

Part III, on "Photometry and Heat," more especially the former, contains much that is of use to the electrical engineer. Part IV, "Outlines of Advanced Work in General Physics," is based chiefly upon researches in the physical laboratories of Cornell University by Professor Nichols and some of his more advanced students, and includes experiments in heat, life studies of artificial light sources, spectral photometry, and in physiological optics, ending with a study of the various methods of exploration of the earth's magnetic field.

Considering both volumes as a whole, they present what we believe to be the best laboratory manual in electrical engineering which has thus far appeared; and, far from being confined in its use to the university laboratory, we are certain that it will be found a most welcome addition to the library of the shop laboratory of every electrical manufacturing establishment. The get-up of the book is in every way commendable, the diagrams and illustrations being good and the type clear.

HOW DOES ELECTRICITY KILL?

BY

F. A. LaRoche

"Does Electricity Kill?" is a question which appears to be among the leading problems of the day. It seems to the writer that this question is so far a foregone conclusion that it is hardly worth a second thought. But change the interrogation and inquire, "How Does It Kill?" At once the subject opens up full of interest. It is on this point that the writer desires to give expression to a few thoughts, based on experiments the recital of which may prove of interest.

At different times during the writer's experience, it has been his fortune or misfortune, to accidentally place himself in connection with currents of great power and on two memorable occasions, shocks were received that were simply terrible. The first notable event happened something like six years ago while he was adjusting a 50 light arc dynamo operating 48 arc lamps, all lamps being adjusted to 45 volts each. As all constant current arc lamps are placed in series, there was a difference of potential between the main lines of 1960 volts. The total resistance of the line lamps being 196 ohms, it follows that a current of 10 amperes was flowing at that time. In attempting to secure the wire in the binding post of machine which he noticed was loose, the writer took the wire which was bare at that point in one hand, and the binding-post in the other, and immediately received a shock which felt as if some one had hit him in the back of the head with a blunt instrument. He also felt a warm glow throughout his body especially in the arms and wrists and his hands were also somewhat burnt at the point of contact. He then remembered no more until some ten minutes after when he regained consciousness which was accompanied with the most horrible nervous trembling that it is possible to imagine. Although the sensation gradually lessened, it was his constant companion for fully two weeks before it completely disappeared.

The machine was a non-regulating one and it is probable that the writer owes his escape from death to that fact as the resistance of his body from hand to hand was about 800 ohms and it follows that with 800 ohms + 196 ohms, namely line and lamps, at an electro motive force of 1,960 volts, only 2.3 amperes passed through his body, instead of 10 amperes.

The second experience is less than two years old and it came about while making tests of a number of experimental instruments. The agent in this case was an alternating current, while in the previous one, it was a direct current. The shock was received with effects at first precisely similar to the first, with the exception that the state of insensibility was not of such long duration and the after nervous effects did not last for more than a few minutes. At least, the next day he went about his duties feeling none the worse for the shocking.

The current in this case was 1,600 volts constant potential alternating at 16,000 per second; his body being 800 ohms resistance, only 2 amperes passing through it. Frequently in experimenting in his laboratory on high tension and high frequency currents, the writer has had 450,000 volts pass through his body, the quantity being however, only the fractional part of an ampere. It therefore follows that a high potential or great number of volts does not do the killing; it is entirely the quantity of current passing through the body. Here are two examples in his own experience where severe shocks from great currents were received, both direct and alternating, and he still lives to relate it.

Yet this does not prove by any means that electricity does not kill. But how and under what conditions? To solve this problem some experiments were made with animals. The first experiment was performed upon a full grown cat in the following manner: Two plates of metal separated but a short distance from each other were secured to a table. Next a terminal was secured to each plate so that when the cat stood with her forefeet upon one plate and her hindfeet upon the other, the circuit was completed through her body. Her feet were thoroughly saturated with salt water with the effect of greatly decreasing her electrical resistance. When all arrangements had been completed, the current was turned on and puss was introduced to a shock of 1000 volts. With a spasmodic jerk she instantly sprang into the air, but landed again upon the plates where she remained stark and rigid for about two minutes while the current was on, but when it was cut out, the body instantly settled down upon the plates with eyes wide open, but the cat was insensible and to all appearances dead, as there was neither respiration nor apparent pulsation of the heart.

The next move was to resuscitate the animal, if possible. Ammonia inhalations and artificial respiration were resorted to and finally the cat again showed signs of life. She breathed distinctly and after a short time had entirely recovered. Again the current was applied and the contracting muscles gave evidence of its presence after a moment or two. The current was then immediately cut off and an examination made, when we discovered that the cat still lived and it was not until after the fifth shock that the cat was really dead. Other cats were experimented upon and the results varied but little from the above, but the last, and possibly most interesting experiment was carried on with a fox.

As the subject from the outset gave us trouble, being provided with two rows of exceedingly sharp teeth, which he appeared to be more than willing to use as not less than two of the attendants can testify, it became necessary to render him more docile, and under the soothing influence of sulphuric ether, he was soon ready for the operation. Two sponges saturated with salt water were secured to the terminals, one of the sponges was made fast to both forefeet and the other to his hindfeet. The fox was breathing regularly and his muscles were relaxed when the current was passed through his body and quickly shut off. After the first spasmodic contraction of the muscles, there was no change, the animal breathing as regularly as before although still unconscious. After another shock of short duration had been given him, the current was increased to 1500 volts, and when turned off, the fox was still alive, the effects of the ether having entirely passed off.

Finding that his long thin legs were introducing a great resistance to the current, the electro motive force was increased to 2000 volts, then broken and rapidly made and broken for about twenty seconds, with about one make and break to the second. After the current had been cut out, an examination was made and it was found that the fox was dead; dead, sure enough, for no amount of working could revive him and an autopsy was unnecessary to complete the work.

Finally in summing up to answer the primary question "How Does Electricity Kill?," it will be observed in both accidents that befell the writer that there was in each case but one shock of short duration. In the experiments with the cat and fox, the number of shocks in the former case were but few compared with those of the fox, although the time was of longer duration. In the latter case, the time did not exceed 20 seconds and the current was made and broken about twenty or thirty times, while in the first experiment, the make and break took place but a few times, with a current of a minute or two's duration each time, and both experiments resulted in the death of the animal; consequently both methods are certain to kill if carried to a conclusion.

The shock and prolonged application of current probably caused the disintegration of the fluids of the body through electrolytic action. The second experiment is more certain and quicker, as the sudden transit of the body from zero to a high state of electrical tension and the repeated cessation and repetition of the same, might be regarded as equivalent to a series of heavy blows from a powerfully wielded bludgeon and that death resulted in much the same manner, and therefore was but little due to electrolysis.

To destroy animal life it follows that the best method is to shock the body in quick succession with many shocks for about thirty seconds with a current either alternating or direct and of from 1,200 to 1,500 volts and of as great a volume as the body will admit, which is in direct proportion to its resistance. Judging from personal experience, it is the writer's firm belief that in some cases where persons have been shocked to apparent death, it is only a case of suspended animation and that it is quite possible to revive them.

It is a great pity that the State of New York should have adopted this beautiful force of Nature, to destroy man. The execution is barbarous, as it has often been proved that the first shock never or rarely proves fatal, and that it requires a series of shocks, which are necessarily of a very painful nature, to accomplish the result.

It has also been proved that death results from the actual burning of the tissues, but it has been shown that it is quite possible for a person to receive a shock of great electromotive force and small quantity of current without this taking place, and while he may be apparently dead, yet it is quite possible to revive the victim by means of artificial respiration, subjecting the body to a high state of temperature and injecting spirits.

It has also been demonstrated that a current of from 1 to 10 amperes does not destroy any of the vital organs and that it is the larger quantities, say, of from 10 to 20, or possibly even a higher number of amperes that burns the tissues and destroys the blood corpuscles. Therefore why is it not reasonable to assume that when a person has been shocked to apparent death and there is nothing vital destroyed in the system, that life should not be restored? If a current of too small volume is used, be the tension what it may, the subject is simply placed in a state of suspended animation; all organs remain intact, and as there is absolutely nothing destroyed, it is by no means certain that a subject in this state will die. On the contrary, there are substantial reasons for believing that consciousness would return of its own accord in many cases, where the victim is primarily sound.

With these facts in mind it must certainly be a man of peculiar temperament who would consent to perform an autopsy on the body of a human being where death is in doubt, for so large is the average of recovery, that the operators at such autopsies must in some cases perform the functions of an executioner.

In the opinion of the writer, an intermittent direct current of a frequency not greater than sixty per minute, is more deadly than an alternating current of equal electro motive force. With an alternating current of high frequency, say, 16,000, a body would act as a condenser, choking back the current, and the higher the frequency of the alternations the greater the impedance to the current, so that after the first contact was made, there would be no sensation of current passing because the great frequency would prevent the body from returning to zero, its normal state.

LETTERS TO THE EDITOR.

ARMATURE-DISCS AGAIN.

Having noticed a reply of Mr. Hobart's to my recent article on armature-disc cutting in your issue of Dec. 19, I will say that there was therein no idea of criticising Mr. Hobart for anything he did not say, as he had evidently not attempted to dwell upon the subject in full. What he did say was all right as far as it went, but I still adhere to the opinion before expressed that the processes of milling out armatures, or cutting them by step-by-step indexing, both of which require too much time and care, by too high-priced operatives, cannot in the long run compete with more rapid methods. I do not question that these processes are carried on in certain shops, as Mr. Hobart states, and it is quite probable that with the personal care a man of his judgment and skill would exercise in over-seeing such work, it would be well enough done.

In regard to the five-weeks-old dies he speaks of, I refer my readers to what I before said upon this subject, the gist of which was that ordinary dies will soon break down and are a source of great annoyance, *but* that it is quite possible to make these dies in such a way (although I do not know of its having been done to any great extent) as to avoid all this trouble, and thus produce perfect discs in a far cheaper manner than they usually are produced at present.

OBERLIN SMITH.

BRIDGETON, N. J., Dec. 24, 1894.

STEAM ENGINE RATINGS.

In a lecture by Gano S. Dunn delivered before the New York Electrical Society and published in your valued medium of Dec. 13 1894, page 481, vol. XVIII, No. 345, the assertion is made :—

" The steam engine is rated by the diameter of its cylinder and length of stroke and speed. It is not sold by horse power because an engine which could develop 100 horse power at $\frac{3}{10}$ cut-off would develop 200 horse power at $\frac{6}{10}$ cut-off, etc."

The writer fails to find such to be the case if, for no other reason, than that the mean effective pressures in an engine are not directly proportional to the varying points of cut-off. In order to illustrate more clearly the facts of the case, some standard formulæ are introduced, which, in general, may be interpreted as follows :—

$$\text{H. P.} = \frac{Ps \times A \times M.\,E.\,P.}{33{,}000}$$

in which :—

H. P. = Indicated horse power.
Ps = Travel of piston in feet per minute.
A = Area of piston in square inches.
$M.\,E.\,P.$ = Mean effective pressure in pounds per sq. inch.
Ip = Initial pressure " " " " "

and :—

(a) $M.\,E.\,P. = \frac{34 \times Ip}{57}$ at $\frac{1}{4}$ cut off.

(b) $M.\,E.\,P. = \frac{11 \times Ip}{13}$ at $\frac{1}{2}$ cut-off.

An application of these formulæ in an appropriate example, may be considered in the following problem :—

It is desired to determine the I. H. P. of an engine whose cylinder is 10 inches in diameter and whose stroke is 12 inches, operating at 300 revolutions per minute, the initial steam pressure being 100 lbs. per square inch, cutting off at $\frac{1}{4}$ and $\frac{1}{2}$ stroke, respectively :—

(a) $M.\,E.\,P. = \frac{34 \times Ip}{57} = \frac{34 \times 100}{57} = 59.65$ at $\frac{1}{4}$ cut-off.

(b) $M.\,E.\,P. = \frac{11 \times Ip}{13} = \frac{11 \times 100}{13} = 84.6$ at $\frac{1}{2}$ cut-off.

$A = \frac{\pi}{4} \times \text{diameter}^2 = .7854 \times 10^2 = 78.54$ sq. inches.

Ps = 2 feet per rev. and 300 revs. per minute = 600 feet per minute.

$$1 \text{ H. P. at } \tfrac{1}{4} \text{ cut-off} = \frac{Ps \times A \times M.\,E.\,P.}{33{,}000} = \frac{600 \times 78.54 \times 59.65}{33{,}000} = 85.18.$$

$$1 \text{ H. P. at } \tfrac{1}{2} \text{ cut-off} = \frac{Ps \times A \times M.\,E.\,P.}{33{,}000} = \frac{600 \times 78.54 \times 84.6}{33{,}000} = 120.8$$

Inasmuch as the author of the paper quoted from, states in substance that the power of a steam engine doubles with double the point of cut-off, and as the above solved problem shows (disregarding condensation and other incidental issues), the increase in power of the engine referred to is 30 per cent. at double the point of cut-off, the writer believes that the above formula is correct and the author quoted from is in error.

THOS. J. FAY.

NEW YORK, DEC. 22, 1894.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 25, 1894.

Conductors, Conduits, and Insulators :—

Insulator, L. McCarthy, Boston, Mass., 531,428. Filed Nov. 19, 1894.
A chandelier ceiling insulator in which the insulating material is molded around the conducting parts.

Electric Cable, T. Guilleaume, Cologne, Germany, 531,614. Filed Apl. 26, 1892.
A telephone cable in which the flat wires are made up in pairs insulated from one another, the wires or ribbons being laid flat against one another and the whole group then twisted together.

Distribution :—

Electric Lighting System for Railway Cars, M. Moskowitz, Newark, N. J., 531,421. Filed Aug. 10, 1894.
Two or more armatures are arranged on the car axle and connected in series to produce the required potential from a comparatively slowly rotating car axle.

Dynamos and Motors :—

Controlling Electromagnetic Machines, W. I. Donshea, New York, 531,365. Filed Jan. 29, 1894.
Controls the field magnets of dynamos by exciting the field from a source exterior to the machine itself, when throwing the machine into use, and before closing the armature circuit and converting it into a self exciting machine before or while throwing it out of use, so that the field discharge is accomplished gradually.

Commutator, H. L. Bridgeman, Blue Island, Ill , 531,406. Filed July 3, 1894.
The commutator consists of an insulated portion composed of a frame of insulating material and the conducting portions filled in by electro-deposition.

Starting Alternating Current Motors, L. Bell, Boston, Mass., 531,482. Filed July 8, 1893.
Claim 1 :—
The method of operating an alternating current motor supplied from a transformer having a divided secondary coil which consists in arranging the divided secondary coils in series to start the motor and changing the relation to multiple when the motor attains speed.

Electro-Metallurgy :—

Magnetic Ore Separator, C. G. Buchanan, New York, 531,301. Filed May 12, 1893.

Apparatus for Extracting Metals, A. Guillaume, Chicago, Ill., 531,309. Filed Jan. 30, 1892.
Electrolyzes the molten metal-bearing material.

Lamps and Appurtenances :—

Electric Arc Lamp, E. J. Murphy, New York, 531,422. Filed Feb 16, 1894.

Electric Cut-Out, H. Hansen, Everett, Mass., 531,310. Filed Jan. 23, 1894.

Miscellaneous :—

Hinge for Electric Apparatus, A. B. Davis, Elkridge, Md., 531,515. Filed May 12, 1894.
Employs a pintle of non-oxidizable metal instead of iron.

Automatic Rheostat, R. W. Hollis, Atlanta, Ga , 531,617. Filed Apl. 30, 1894.
An automatic starter for motors and which also acts as a cut-out when the current is shut off.

Railways and Appliances :—

Trolley, C. E. Powell, Philadelphia, Pa., 531,331. Filed Oct. 31, 1894.
The bracket holding the trolley wheel is provided with a fender consisting of two outwardly projecting arms.

Electric Conductor Support, J. M. Anderson, Boston, Mass., 531,354. Filed July 9, 1894.
Claim 1 is as follows:—
The combination with a support of electric conductors comprising grooved end portions, and an intermediate portion weaker than the said end portions, of a bridge or anti-buckling device intermediate of the said end portions and re-inforcing the weaker intermediate portions of the support.

Fuse Box, C. L. Ashley, Atlanta, Ga., 531,355. Filed Apl. 30, 1894.
An automatic magazine fuse box.

Means for Controlling Electric Locomotives, E. Egger & F. A. Wessel, New York, 531,366. Filed May 17, 1893
Employs a constant-speed electric motor with conical pulleys on the motor and car axle, respectively, connected by a driving belt which can be shifted.

Trolley Catcher, P. D. Milloy, Buffalo, N. Y., 531,380. Filed Apl. 2, 1894.
Consists of a cylindrical barrel having a weight and a compression spring acting conjointly to draw down the rope when the bolts are released.

Trolley, G. A. Newhouse, New Albany, Ind., 531,383. Filed July 28, 1894.
Permits of the oscillation of the fork holding the trolley wheel, independent of the trolley pole.

Trolley Wire Bracket, W. S. Kline, Bolivar & J. B. Westhafer, New Philadelphia, Ohio, 531,437. Filed Oct. 17, 1894.

Electric Railway, C. H. Macloskie, Schenectady, & H. M. Brinckerhoff, Matteawan, N. Y., 531,441. Filed May 17, 1894.

A system in which the conducting rail is placed outside and adjacent to the track rails with special arrangements for breaking continuity between the main and branch conductors and switching points.

Electrical Connections for Railway Rails, A. J. Moxham, Johnstown, Pa., 531,445. Filed June 2, 1894.

A method of cross connecting the rails electrically in which the conductors are formed into flexible loops between the rails.

Conduit Electric Railway, W. H. Swift, Boston, Mass., 531,450. Filed Apl. 27, 1894.

Structural improvements in conduit railways.

Electric Locomotive for Elevated Railways, F. B. Behr, London, Eng., 531,499. Filed Feb. 27, 1894.

This is a construction adapted for single track elevated roads, with lateral guide rails.

Telephones:—

Electric Plug Switch, A. H. Palmer, Utica, N. Y., 531,494. Filed Oct. 17, 1894.

SOCIETY AND CLUB NOTES.

N. E. L. A.—CLEVELAND PROGRAMME.

Below is given a partial list of the papers to be read at the Cleveland meeting of the National Electric Light Association, to be held February 19, 20 and 21:—

Some Economies in Electric Light and Power Stations, by Professor Edward Weston; Arc Carbons and The National Electric Light Association Standard of Light, by L. B. Marks; The Monocyclic System, by Dr. Louis Bell; The Correct Method of Protecting Electric Circuits, by W. E. Harrington; The Evolution of Arc Lighting Machines, by C. N. Black.

Mr. E. A. Leslie's paper, read at the Buffalo meeting, and entitled "The Operation of High Tension Currents Underground from a Physical and Financial Standpoint," will be taken up and discussed.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. The regular monthly meeting of the Western members of the Institute was held at Armour Institute, Chicago, on December 19th last with Mr. L. L. Summers in the chair. The meeting was not as well attended as usual, a great many members happening to be out of the city that week. The feature of the evening was the presentation of the paper by Mr. Ludwig Gutman "On the Production of Rotary Magnetic Fields by a Single Alternating Current." At the request of the chairman the paper was read in full, after which an interesting discussion followed, participated in by Messrs. Arnold, McFadden, Summers and others. The principal points raised in the discussion were whether or not practical machines could be constructed from the diagrams given, the author explaining that the diagrams had been purposely simplified as much as possible. It was also pointed out that, judging from the diagrams, the efficiency of the apparatus would probably be very low. To this the author replied that, as already stated, the diagrams were made as simple as possible, so as to be easily understood, and that by properly proportioning the machines as regards iron and copper, high efficiency would be obtained.

LEGAL NOTES.

TELEPHONE PATENT SITUATION—ANOTHER NOTE.

In *The Electrical World* of December 29, in an article entitled "The Telephone Patent Situation," appears the following:

Other combination patents are, however, in force with longer terms before expiration which are of sufficient importance to demand attention. The most important of these are, perhaps, those of Thomas Watson, issued Jan. 9, 1883, numbered 270 522, and April 16, 1878, numbered 202,495. The former of these two broadly claims the combination of the induction coil with any form of a switch which severs the "call" circuit and "makes" the talking circuit, or the reverse. This patent does not expire until Jan. 9, 1900, and by some writers of very recent date has been considered to be almost an unsurmountable obstacle in the equipment of a subscriber's station by a competitor of the American Bell Telephone Company. But when we consider the fact that for several years such a combination and switch have constituted an abandoned method by the American Bell Telephone Company, it is useless to spend any more "sleepless nights" over the subject. The latter patent, however, No. 202,495, claims broadly the use of a signalling apparatus in an independent or branch circuit, arranged and adopted to call the attention of the distant operator, and were it not that this patent expires in less than four months, on April 16, 1895, it might cause considerable uneasiness for the would be competitor.

It is true, as our esteemed contemporary states, that for some time the American Bell Telephone Company have been changing over from the circuits covered in patent No. 270,522 to a more efficient method, which seems to be the basis for the above quoted expression "it is useless to spend any more 'sleepless nights' over the subject." *The Electrical World*, however, failed to give its readers the information that this new method is also covered by a patent—a later and much better patent than the Watson patent, No. 270,522. In THE ELECTRICAL ENGINEER'S article, Dec. 26, on the same subject, this new method was referred to and briefly described, the information also being given that the patent covering the organization of circuits is that of J. J. Carty, and the system is popularly known as the "bridging bell system." The date of the patent is March 31, 1891, and the number is 449,106. The first claim of the patent is as follows:

A multiple-station telephone-circuit, a call-bell magnet of relatively high resistance, as specified, at each station, included in a branch circuit uniting the two sides of said telephone-circuit, and a generator of electricity for sending calls at each of said stations, adapted when operated to be connected between the two sides of said telephone-circuit in multiple arc with the call-bell magnet, substantially as described.

Information just reaches us that a suit has been commenced in Chicago by the Western Electric Company against the Western Telephone Construction Company, for the alleged infringement of patent No. 202,495, and that in addition to the three suits already brought against the Harrison International Telephone Company, the Western Electric Company are understood to be preparing another suit (if they have not already brought it), on the patent of Watson of January 9, 1883, No. 270,522.

In the series of articles on "The Telephone Patent Situation," which appeared some time ago in THE ELECTRICAL ENGINEER and which have since been largely called for in their pamphlet form, there appeared with reference to the Watson patent, No. 270,522, the following statement: "This patent, especially in connection with those of Roosevelt, Phelps and Gilliland, has been responsible for many sleepless nights to many inventors. The first claim of the Watson patent would seem to be especially productive of insomnia." We are naturally much gratified with the close manner in which the writer in *The Electrical World* has followed our series of carefully prepared articles. We cannot, however, quite endorse his proposed remedy for insomnia, which consists in avoiding a patent which runs out on January 8, 1900 and in infringing a better and more recent one which does not expire until 1908.

BRILL TROLLEY CAR TRUCKS—ALLEGED INFRINGEMENTS.

Two suits which have been brought in the United States Circuit Court by John A. Brill against the Hestonville, Mantua and Fairmount Passenger Railway Company, and the Delaware County and Philadelphia Electric Railway Company, it is said, are to have a hearing as to alleged infringement on Brill's patents by a number of trolley roads. The patents cover the maximum traction truck, known as the "Eureka" truck, the Independent Rigid truck, the spring supported axle-box frame devices for supporting electric motors, brake mechanism, platform gates, etc.

LAMP INJUNCTIONS DISSOLVED—STAR AND SUNBEAM COMPANIES FREE.

ANOTHER interesting phase of the many-sided incandescent lamp litigation was reached last week in Chicago, when Judge Seaman, in the United States Circuit Court dissolved the injunctions against the Star and Sunbeam Lamp Companies, pending the decision that is expected in Washington at an early date, in the Bate Refrigerator case; the dissolution is to take effect upon the filing of bond by the defendants. The parties thus freed are preparing to resume business.

THE OTTAWA WINTER CARNIVAL.

MR. T. AHEARN, the well-known electrician, managing director of the Ottawa, Can., Electric Railway Co. writes us as follows:

"I will esteem it a favor if you will kindly notice in your valued paper the fact that a grand Winter Carnival will be held in this city, commencing January 21st, and continuing until the 26th. Our winter weather is practically the same as that of Montreal, where, as you are probably aware, very successful winter carnivals have been held. Ottawa is the political capital of Canada and is but 3½ hours from Montreal. It is beautifully situated and has a population of 50,000, all progressive people. The city should be especially attractive to my electrical confreres, as Ottawa is generally recognized as electrical headquarters, and in proportion to population, it has, I may venture to say, on a larger scale than any other city in America adopted electricity in its various domestic applications. The operation of our electric railway in the midst of a Canadian winter should be in itself interesting. Our street railway system with its water-power power house has always been a subject of much favorable comment from our American cousins.

"Will THE ELECTRICAL ENGINEER kindly extend in behalf of our Carnival Management a hearty invitation to any and all of your readers and their friends to visit Ottawa during Carnival week?"

THE ST. LOUIS IRON AND MACHINE WORKS, Main street and Chouteau avenue, St. Louis, Mo., are building a 100 H. P. 30" x 54" heavy duty "St. Louis Corliss" engine for the Union Depot Street Railway Co. of St. Louis, and also a cross compound 26" x 50" x 48" 800 H. P. for Kansas City, Mo.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE GREEN ECONOMIZER FOR CENTRAL STATIONS.

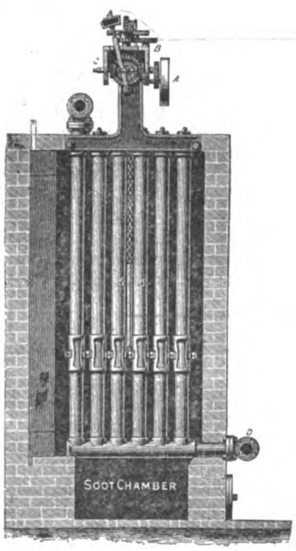
In the description of the central power house of the Montreal Electric Railway system in our last issue, mention was made of the use of the Green economizers as constituting a part of the steam plant, which tests have shown to be remarkably economical of coal. The Green economizers have been in successful use for many years abroad and are now being rapidly introduced in the United States by the Fuel Economizer Co., of Matteawan, N. Y.

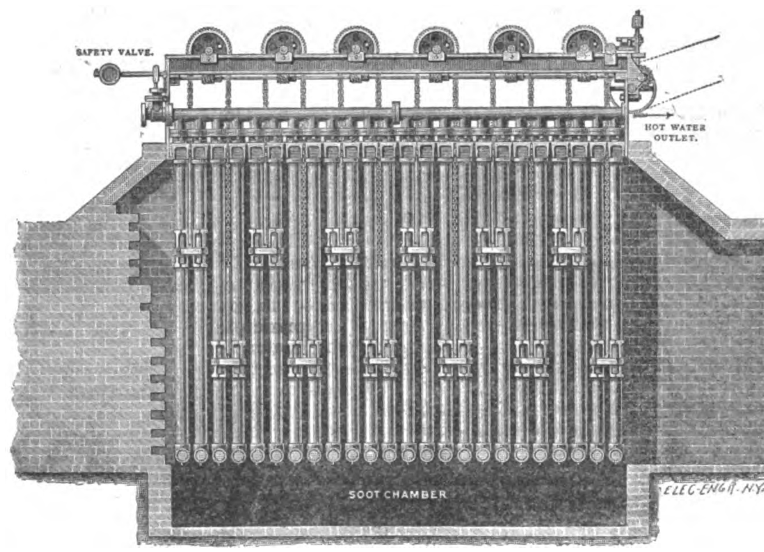
The Green economizer, which is illustrated in the accompanying engravings, consists of a set of cast-iron pipes, about four inches in diameter and nine feet in length, made in sections (of various widths), and connected together by "top" and "bottom headers." These, again, are connected by "top" and "bottom branch pipes" running lengthwise, one at the top and the other at the bottom, on opposite sides—both outside the brick flue which encloses the economizer. The waste gases are led to the economizer by the ordinary flue from the boilers to the chimney. The feed-water is forced into the economizer by the boiler pump or injector, at the lower branch pipe nearest the point of exit of the gases, and emerges from the economizer at the upper branch pipe nearest the point where the gases enter.

Each pipe is provided with a scraper, which is made to travel continuously up and down the pipe at a slow rate of speed, the object being to keep the external surface clean and free from soot which is a non-conductor of heat. A space is provided at the bottom of the chamber for the collection of soot, which is thrown off by the scrapers.

The mechanism for working the scrapers is placed on the top of the economizer, outside the chamber, and the scrapers are moved up and down by rods and chains, which pass through small openings in the top of the machine. The motive power is supplied by a belt or from some convenient shaft; the power required is so small as to be immaterial. The apparatus is fitted with blow-off and safety valves.

Besides heating the feed water from the waste heat from the steam boilers, the use of the economizer adds considerably to the life of the boilers, the high temperature of the feed water preventing the usual expansion and contraction.





Green Economizer for Central Stations.

ELECTRIC LIGHT IN THE NEW YORK HERALD NEW BUILDING.

This establishment has one of the finest electric plants in New York. It consists of four large dynamos of 3,000 incandescent light capacity and several motors for various work. One of the most attractive feature of the whole electric plant is the use of fine artistic arc lamps in the press room. This is the only newspaper in America that exhibits its entire printing presses in such a way that the public can stand upon the side-walk and see the paper enter the press and come out printed and folded ready for delivery. For this establishment, the question of light is an important feature. Over nine months ago, the managers began experimenting with arc lamps from incandescent current. All the makers of arc lamps were given an opportunity to place their lamps on trial in this room, and they availed themselves of this invitation with great promptness. After nine months of trial the Clark Electric Company's lamps were selected as being in the judgment of the managers the best in every respect. The Clark Company had a special fixture made for the purpose which comprises a combination of electric arc light and gas. The gas is to be used when electricity is not needed. A visit to the Herald, Broadway, 6th avenue, 35th and 36th streets, will be time profitably spent.

THE SYRACUSE STORAGE BATTERY.

Mr. C. L. Pack, the secretary of the Syracuse Storage Battery Co., which operates under license from the Consolidated Electric Co.'s patents, and has an excellent cell of its own, writes us very hopefully as to the situation and outlook. It has just closed a contract with Dey Brothers, in Syracuse, N. Y., for a plant in that concern's large new building. The expenditure on the plant amounts to about $5,500. As the installation will be right in the centre of the city, it will be a good "ad." for the Syracuse batteryl and will of course be very accessible to the many visitors who wil, wish to see it.

THE CINCINNATI EDISON CO.

The Cincinnati Edison Electric Company completed by Christmas all connections necessary for the purpose of lighting up its Third District. Rapid progress is being made with the Fourth District, which will be finished by the first week in January. For these two disiricts over 400 arc lamps of 2,000 c. p. each, about 100 miles of wire and nearly 3,000 poles will be used. By the latter part of spring or first of summer the two large districts, Fifth and Sixth, requiring nearly 1,200 arc lights and 150 miles of wire, will be completed.

The machinery, dynamos, etc., necessary to supply electric lighting power for these districts are now in the station. That part which is to supply the Third District is in place, while the rest is rapidly being put in readiness for business. A rope drive is used to transmit the power instead of belting.

ENGINE BIDS FOR THE NEW CONGRESSIONAL LIBRARY.

Bids were opened by Bernard R. Green, Superintendent and Engineer of the construction of the new Building for Library of Congress, on Dec. 20, 1894, for furnishing, delivering and putting in place complete three 16x15 high speed, horizontal, centre crank, single valve, automatic steam engines for the Library Building. The following is a list of the bidders: Ames Iron Work, New York, N. Y., $6,300; Geo. C. Howard, Philadelphia, Pa., $4,500; Stearns Manufacturing Co., Erie, Pa., $4,680; Morton Reed & Co., Baltimore, Md., $5,700; Crook, Horner & Co., Baltimore, Md., $4,637; Pierce & Miller Engineering Co., New York, N. Y., $7,495; Justus W. Parker, Philadelphia, Pa., $5,120; B. W. Payne & Sons, Elmira, N. Y.. $7,200; Walter L. Clark, New York, N. Y., $8,900; Watertown Steam Engine Co., Watertown, N. Y., $4,750; W. R. Fleming & Co., New York, N. Y., $6,999; Fisher Foundry & Machine Co., Pittsburg, Pa., $3,463; Buckeye Engineering Co., Salem, O., $5,200.

LIGHTING IN CLEVELAND.

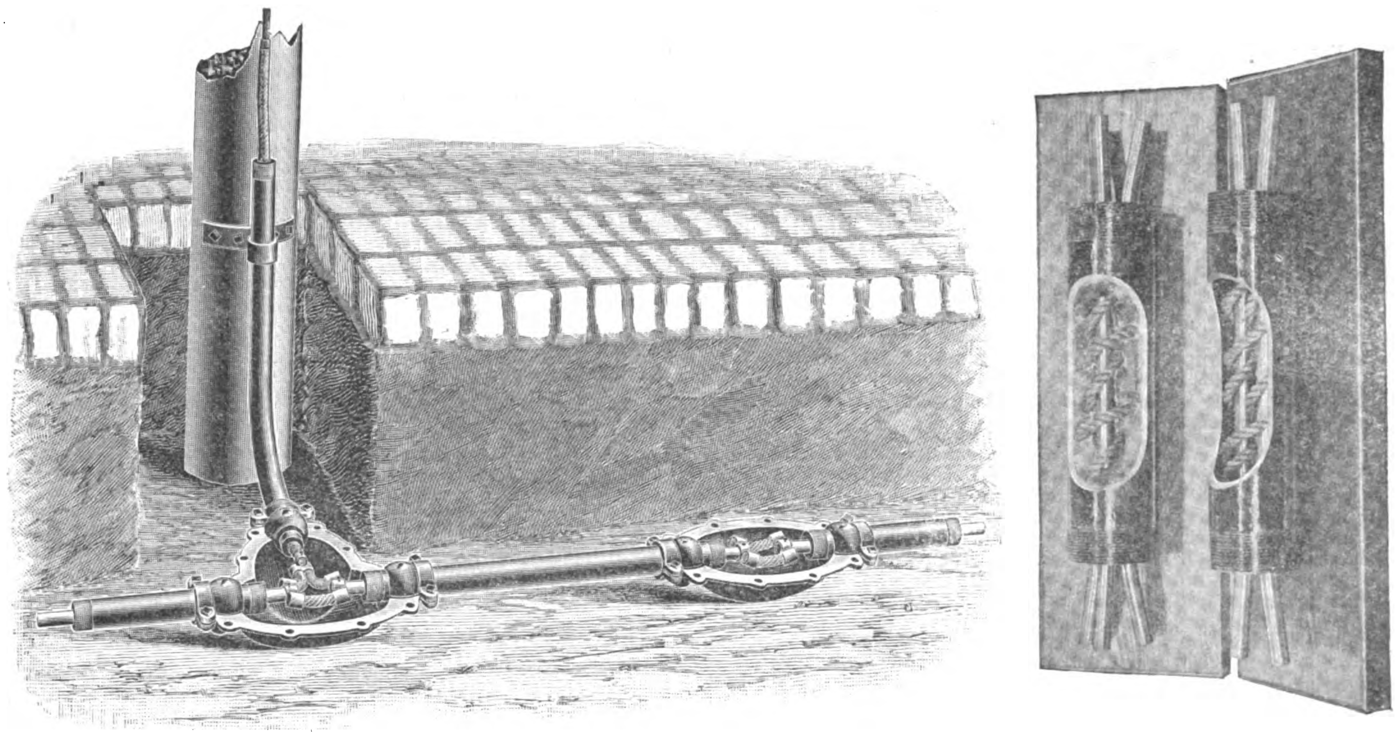
Director Farley in Cleveland has proposed the use of 600 c. p. arc lights one-third nearer together, instead of 1200 c. p. arcs.

The project for lighting the county buildings with electricity, is not dead, and there is a strong probability that a lighting plant will be established within a few months, or perhaps the county will buy its electricity from the local lighting company. The County Commissioners have invited bids from several dynamo manufacturers, and also from the lighting company for furnishing the lights. That there will be electricity in the buildings is an assured fact.

UNDERGROUND TUBES FOR RAILWAY FEEDERS.

THE success which has attended the use of the underground feeder in the electric street railway practice of Philadelphia, has called general attention to the desirability of doing away with the objectionable obtrusion of the overhead feeder wire and substituting for it the equally effective underground feeder. The question is coming rapidly into prominence, especially in large cities where the overhead feeder has in many cases no better excuse than its rapidity of installation.

Some four years ago the Milwaukee Street Railway Company determined on a system of underground feeders. The Edison system of underground tubing, so well and favorably known in the field of electric illumination, was selected and proved entirely successful. This led the General Electric Company to develop a full line of fittings, joints, boxes, pole tubes, etc., to meet a demand for underground railway feeders which has already commenced and is increasing.



UNDERGROUND TUBES FOR RAILWAY FEEDERS.

The advantages of the system of underground tubing are already fully emphasized by the fact that 150 miles are laid in New York alone, and that Chicago, Philadelphia, Boston and other large cities are similarly canalized.

The underground electric tube consists of one or more conductors contained in and insulated from a steel pipe. Each tube, forming one section, is as complete when it leaves the factory as is a rail from a rolling-mill, and, like a rail, need only be joined to other units to form a continuous line. For railway work these tubes have been standardized between 200,000 and 1,000,000 C. M. in single, double and triple conductor form. The conductors, of pure lake copper, tinned, are 20 feet 4 inches long and project some two or three inches beyond the end of the thoroughly japanned welded steel tubes. Every precaution is taken in the manufacture of these tubes to ensure perfection of insulation and efficiency. The compound used is the result of twelve years' experience, and is tough and plastic even below freezing point. Thus it can adjust itself to any expansion, contraction or other movement of the tubes. The junctions and branches are effected by means of boxes and flexible couplings, the boxes being filled with the compound after connection is made, and sealed.

A few of the important characteristics of this system are the following: It has no ducts to fill with gas and blow up manholes; it may be tapped at any point without the necessity of a manhole; it does not allow of return circuits, and avoids to a great extent electrolytic dangers; tubes takes up little or no room in the street; the system is durable; the insulating compound does not crack in cold weather and will stand a heat which would speedily ruin hard rubber, and the tubes ⅛ in. thick are not easily pierced. The system is "ironclad" and as such offers greater advantages generally than any other system of armored cables for railway underground feeder work.

UTILIZING THE SUSQUEHANNA RIVER ELECTRICALLY.

A scheme to utilize water-power in the Susquehanna river, is being carried out by a company, with M H Houseman, Geo. K. McGaw, J. S. Bull and W. J. Taylor, of Baltimore, and Chas. R. McConkey, of Peach Bottom, Pa., as incorporators. The initial capital is $100,000. The company intends utilizing the power furnished by a section of the Susquehanna river, beginning at Ball Friar's Point, one mile above Conowingo, Md., where the river is nearly a mile wide. Here a dam of masonry between thirty and thirty-five feet high will give a head of forty-seven feet. Above the point is a natural basin or widening of the stream where a vast supply of water can be stored. The head of water from this dam will be used in operating a plant of large turbine wheels, which in turn will furnish the power to operate a system of dynamos. It is calculated that with this fall of water between 30,000 and 40,000 horse-power can be obtained. The current will be transmitted to Baltimore, and possibly to Wilmington and Philadelphia. The power house, like the dam, will be built of granite, which is plentiful in that locality. It will be on the north side of the river and an abandoned canal bed will probably be deepened and enlarged for the power canal. The total cost, it is estimated, will be several million dollars. Conowingo is about thirty-five miles from Baltimore and sixty-five miles from Philadelphia.

THE MUNCIE ELECTRICAL WORKS.

The Muncie, Ind., Electrical Works, continuing under new conditions and in new hands, an industry already established, were incorporated Nov. 17, 1894, with a capital stock of $25,000, for the manufacture of electrical and steam machinery. They still make the iron clad bi-polar type manufactured by the old company before the receivership; and have added a new multipolar type, direct connected to a special automatic compound high speed steam engine of their own design and construction. They are now installing a station at White Hall, Ill., and putting in also a complete underground system. The plant when completed is, they say, to rank among the finest in the country. The officers of the Company are W. S. Richey, president; R. F. Piatt, vice-president; and A. S. Richey, secretary.

NEW YORK NOTES.

MR. FRANK C. PERKINS, E. E. of Buffalo, has, we regret to record, lost his wife, whose death occurred on Dec. 24, at Dunkirk, N. Y.

THE LONG ISLAND RAILROAD CO. have placed a contract for their new pier shed with the Berlin Iron Bridge Co., of East Berlin, Conn. The Berlin Co. are also building a new highway bridge for The Boston & Maine Railroad, at Somerville, Mass.

MR. JOHN MACCORMACK has severed his relations with the Stirling Company, and is still to be found at 126 Liberty street, New York city, as Consulting Engineer. He is ready to execute any engineering or other expert mechanical work.

THE COMMERCIAL CABLE CO. has issued an interesting card that describes the laying of their third Atlantic cable. The story is on one side, and on the other are a number of artistic little pictures neatly grouped, showing episodes in the work.

MR. C. H. MCINTIRE, of the C. McIntire Co. of Newark, N. J., manufacturers of the well-known patent connectors, terminals, joints, &c., has, we are sorry to say, had to take a trip South for the winter on account of poor health.

THE NEW YORK ELEVATED is said to have been dickering with the Westinghouse Co. over apparatus to run the road electrically. Col. Hain will not admit the truth of the report. This is to be regretted, for the old road needs electrifying in more ways than one.

FLEMING DYNAMO BRUSHES.—On Christmas Eve at nine o'clock fire broke out in the factory of Mr. W. H. Fleming in this city, where he manufactured his patent woven wire dynamo brushes. The damage amounted to about $1700, only partially insured. We understand that the work will be carried on without interruption during rebuilding, other premises having been secured.

MR. ARNOLD SPILLER, E. E., the electrician of the Buckeye Electric Co., of Cleveland, O., has just spent a much needed week's vacation in this city. The great and rapid growth in the company's business, which has recently run up to orders for as many as 10,000 and 12,000 lamps in a single day, and a steady output of over 5,000, has thrown heavy work on the factory, under the strain of which Mr. Spiller well-nigh broke down. He has returned, however, to his post, greatly braced up and benefitted by his New York holiday. He looks forward to the Cleveland convention as an opportunity for meeting many of the Company's friends and customers.

THE E. S. GREELEY & CO.'s famous headquarters at 5 and 7 Dey street, were visited by fire on December 24. The origin appears to have been due to a cigarette. It did considerable damage, and the deluge of water thrown on the building from top to bottom also ruined a good many things. But the company's books and papers escaped intact, and in a few hours business was going on as usual, the reserve stock in adjacent warehouses being drawn upon promptly to fill the orders, which were large and pressing, as well as the retail trade. The company does not contemplate removal. The loss on stock, fixtures and machinery is put at $25,000 to $30,000, and on the building at about $5,000, all of which is covered amply by insurance. We are glad to be able to congratulate the concern on not having sustained greater damage, and on its really remarkably prompt continuance of business. There was practically no intermission.

WESTERN NOTES.

KOHLER BROS., Chicago, who represented the Eddy Electric Mfg. Co. so successfully for the past five years have resigned as their Western representatives.

THE PHENIX ELECTRIC SUPPLY CO. of Warren, O., has been formed by Secretary of State Taylor with a capital stock of $1000. It is stated that the company has arranged to purchase the entire output of the New York Electrical Supply Co. of Youngstown, O.

THE GOLD BLUFF MINING COMPANY, of Downieville, Sierra county, Cal., has recently equipped its mine with electric machinery as follows: One 115 H. P. Wenstrom dynamo; one 6-in. Gould's triplex pump, driven by Wenstrom motor; one 18-in. Davidson electric ventilating fan; one 5-ft. Pelton water-wheel with differential governor, and 250 16- c. p. incandescent lamps.

KROELL & MEYSENBERG is the style of a new firm in the Electrical Engineering field, with offices in the Commercial Bldg., St. Louis. Both members of the firm have had years of experience in the superintendence and construction of electric light and power plants and will certainly find a profitable field of operation not only in their city, but wherever generating stations are to be installed.

MR. C. E. SARGENT, of Chicago, so long identified with engine interests and so well-known in these circles in the West, will, on January 1, become the representative in Chicago of the Ball & Wood Company of New York. Mr. Sargent's headquarters for the present will be in the Home Insurance Building where he will endeavor to gain for the Ball & Wood engine in the West the same reputation and popularity that it enjoys in the East.

THE ELECTRIC APPLIANCE CO., Chicago, evidently believe in not merely showing their appreciation of their employés' efforts, but in also encouraging them to become thoroughly familiar with modern business methods. The day before Christmas each of their employés was presented with a copy of "The Successful Business Man," accompanied by a five dollar gold piece. That the gifts were highly appreciated was evidenced by the smile of satisfaction worn by the employés as they left the cashier's window. The Electric Appliance Company are offering something new in the line of an alternating current switchboard instrument made by the Whitney Company. The instrument is of a special form with a large scale particularly adapted for switchboard work. The frame and case is entirely of metal and all connections are made at the back of the board. The instrument does not require recalibration and is not affected by external magnetism and promises to be a "winner."

NEW ENGLAND NOTES.

MR. CHARLES E. ADAMS has resigned the presidency of the Bradbury-Stone Storage Battery Co.

THE UNITED ELECTRIC SECURITIES CO. has elected Mr. Samuel Carr as its president in place of Mr. Proctor, deceased, and Mr. Arthur Perry succeeds Mr. Carr as vice-president.

LEWISTON, ME. The Lewiston Bleachery and Dye company have served a notice on the city that they intend to build an electric railway from the Maine Central yard to their plant. The distance is nearly a mile and the road will be used to transport their merchandise.

BOSTON HARBOR has been quite a submarine cable centre the past week. The cable laying steamer "Minia," commanded by Capt. S. Trott, has been at anchor there and the "Pouyer-Quertier" has been lying a few hundred yards from her. Capt. Trott is a well known figure in Boston and has been exchanging royal hospitalities of the season with members of the electrical fraternity.

PHILADELPHIA NOTES.

THE ROBINSON CO.'s plant for the manufacture of electrical machinery has been sold by the receiver to a party of capitalists from Altoona, who are resuming work with a force of 125 hands.

WE learn that there is an excellent prospect of a speedy adjustment of Queen & Co.'s affairs. Meanwhile their large stock has suffered little diminution, and is being kept up in all departments, orders being filled as usual.

DYNAMOTORS FOR THE NEW CONGRESSIONAL LIBRARY.

THE superintendent and engineer of construction of the building for Library of Congress, is inviting proposals until 2 o'clock, P. M., Jan. 16, 1895, for furnishing dynamotors. Bidders may obtain additional particulars, together with all necessary specifications and contract blanks by addressing Bernard R. Green, Superintendent and Engineer, 145 East Capitol Street, Washington, D. C.

ELECTRIC MINING PLANT NEAR OROVILLE, CAL.

A neat mining installation has been in operation for some time past near Oroville, at the Banner mine of the Development Syndicate, Maj. Frank M. McLaughlin, general manager. All the power for both the mining and the milling is electric. The power house is about two miles distant from the mine and mill, and water is obtained from the Feather River, under 112 ft. head, operating two Pelton waterwheels, which drive two 85 H. P. direct current 500-volt generators. The power is utilized in driving motors operating separately a 10 stamp gold mill, a rock breaker, a 10 x 20 in. air compressor, and two pumps on the 300 and 500 ft. levels of the mine of the Knowles vertical triplex, single acting type, one with plungers of 6½ in. diameter by 8-in. stroke, and the other of the same type with plungers of 5 in. diameter and 6-inch stroke. The hoisting works are also operated by a motor and the mine and mill lighted from the power wires. The plant was installed by the General Electric Company.

☞ *Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.*

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THE FRANKFORT, GERMANY, MUNICIPAL ELECTRIC LIGHT STATION.

BY

Dr. R Haas M. A.

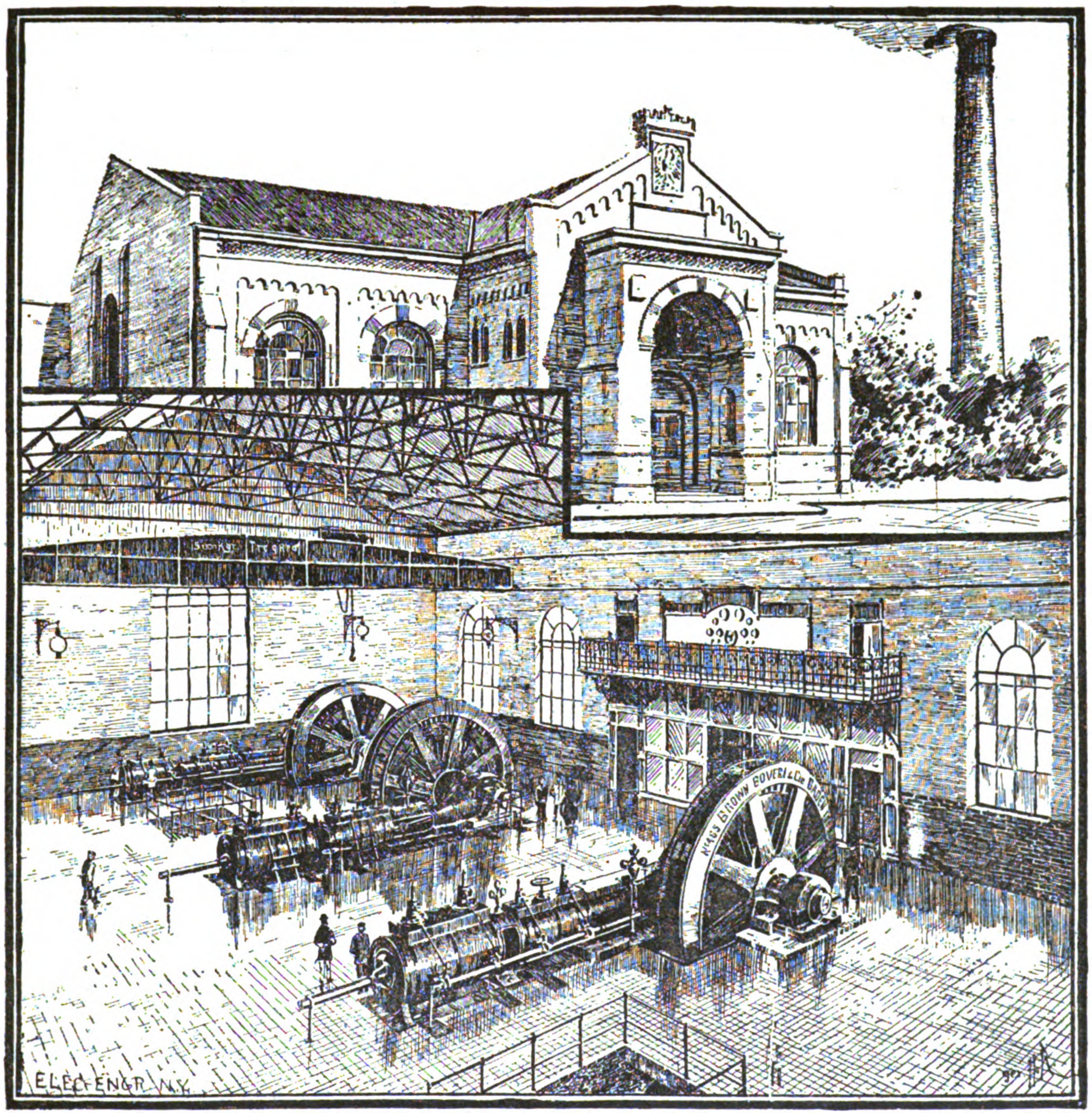

FIG. 1.—THE FRANKFORT-ON-THE-MAIN MUNICIPAL ELECTRIC LIGHT STATION.

I. INTRODUCTORY.

THE first proposition looking to the erection of a plant for supplying current to the city of Frankfort on the Main, Germany, dates back as far as the year 1882, at which period it was thought more practicable to supply the principal districts of the city from a number of block stations by means of the continuous current. While negotiations were still pending with some of the largest firms in Germany, the alternating current rose to considerable prominence, and a sharp controversy ensued. The adherents of the continuous current pointed to the imperfections of the alternating current motor and alternating current arc lamp, whereas the alternate current engineers laid great stress upon the difficulties of economical distribution over extended territory by means of the continuous current. Since accumu-

lators, which admitted of a rational continuous current working, had undergone great improvements it appeared as if there were no way out of the dilemma. The competing firms were, therefore, called upon to show their motors and arc lamps in actual operation. The experts appointed by the city to examine the various apparatus, after exhaustive tests, believed that they had come to the conclusion that the disadvantages of the alternating motors and arc lamps were not so great as to cause the throwing out of the alternating system. In order to obtain a clear idea

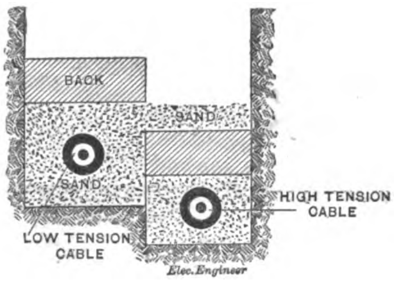

FIG. 2.—ARRANGEMENT OF HIGH AND LOW TENSION CONDUCTORS.

of the different systems carried out on a large scale, the city organized an electrical exhibition in 1891, at which were represented the most prominent firms of Germany and foreign countries. At that time also, the multiphase current was first brought out, which still further served to complicate matters, as it combined many of the advantages of the continuous and alternating current. The combination of multiphase and continuous current systems with sub-station accumulators then became a great rival to the alternating current. The decision finally was in favor of the single phase alternating current and on the 12th of October, 1893, the plan submitted by Messrs. Brown, Boveri & Company, of Baden, Switzerland, was approved of by the City Council. On the 12th of October, 1894, steam was first turned on and since then the station has been in regular operation.

II. THE CENTRAL STATION.

The city of Frankfort a. M. has about 200,000 inhabitants, occupying an area of about 15 square kilometres. The station has an ultimate capacity of 100,000 16 C. P. incandescent lamps burning simultaneously. In the residential quarter of the West End a consumption of 10 watts per running metre of house front is expected, whereas in the centre of the business district the number of watts is as high as 180 per running metre. The central station is built close to the River Main and is situated outside the city, at about 3.5 kilometres from its centre. Coal and water are cheap at that point and easily handled. A narrow gauge underground coal road, 150 metres long, will allow the coal to be brought direct from the boats into the coal storage house. The condensing water is obtained through underground pipes from the river, being stored in two tanks from which it is distributed to the condensers. The heated condensing water is led back to the river through another pipe.

Thus far the station buildings cover 2850 square metres, leaving space for a large increase whenever it shall become necessary. The boilers are return tubulars with smoke-consuming furnaces. Smoke had to be avoided as, with the prevailing west wind, it would have proved a nuisance to the inhabitants of the West End. There are at present 8 boilers, each having 86 square metres of heating surface. As will be seen in the engraving, Fig. 1, none of the piping is visible in the engine room as it is all placed below the floor; but it can be controlled from the engine room as well as from below. Duplicate piping was avoided, but on the other hand all steam mains lead to a large steam drum, which, owing to its solid construction, is looked upon as an absolutely safe element. Besides removing the entrained water this steam drum admits of an even passage of the steam from the boilers, which is all the more important as all the engines when working in parallel draw the steam at the same instant from the steam drum. All the piping is thoroughly protected by anti-condensation covering.

The horizontal compound dynamos of 750 H. P. at 85 revolutions have the Ruchenbecker free acting valve motion. The cylinders are connected in tandem with a common piston rod working on a single crank. This arrangement was chosen for the following reason: When the dynamos, which are keyed to the engine shaft, are thrown in parallel the cranks of the running engines should be at the dead centre at the same time, since by this arrangement a complete synchronism is maintained within a single revolution. According to the opinion of the constructing engineer, the tandem engine keeps better time during the coupling in parallel than the cross compound engine. No provision was made for throwing in a resistance to take the load during the operation of coupling in parallel. The throwing in of an additional machine, notwithstanding its great size, is accomplished without disturbance.

Between the two bearings of the steam engine is situated the enormous magnet frame of the dynamo instead of the fly wheel. The magnet frame carries 64 pole pieces wound with bare copper strips insulated with paper. The magnets are energized by an 8-pole series, continuous current machine, the armature of which is keyed to the free end of the main shaft. This machine has a potential of 80 volts, so that each of the 64 magnet coils on the main shaft has a potential of about 1.2 volts. The armature of the alternating machine is stationary, and, notwithstanding the high potential of 3,000 volts which it delivers, has worked without a hitch. This armature is built of 16 segments, which can be readily replaced, and the conductors are located in holes punched into the discs.

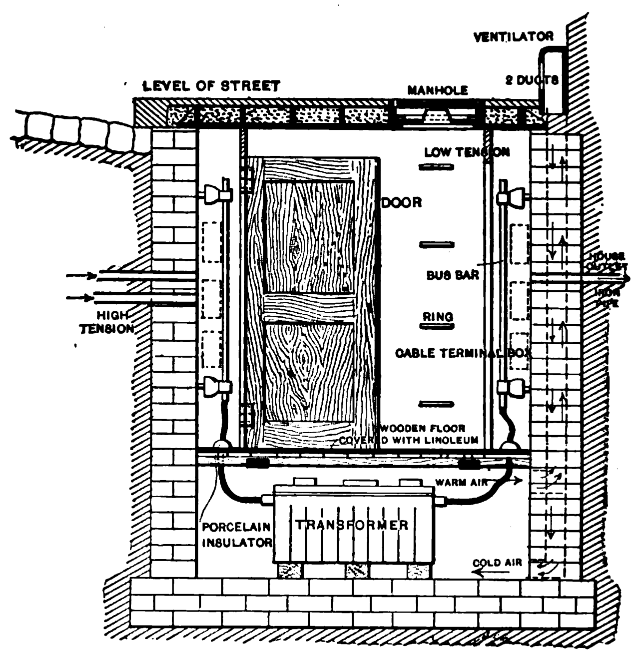

FIG. 3.—TRANSFORMER PIT.

At the present time three steam engines are in position, to which a fourth will soon be added. Each has a capacity of 500,000 watts at 3,000 volts. The boilers and engines were built by the firm of G. Kuhn, of Stuttgart-Berg; the dynamos by Brown, Boveri & Co., Baden, Switzerland. Four cables lead from each dynamo to the switchboard, two of which go to the regulating resistance for the exciting current, while the two others carry the high tension current. The switchboard is located against the wall in a gallery and is exceedingly simple. For each machine it is

provided with one amperemeter and one rheostat for regulating the excitation, with fusible cut-outs and switches, and in addition, with a phase indicator and voltmeter with a transfer switch. Conductors lead to a special switch room where the fusible cut-outs protecting the feeders are located. The whole machanical and electrical equipment is notable for its simplicity and its ease of inspection.

III.—THE UNDERGROUND SYSTEM.

The entire distribution system is underground and consists of three main parts, the high tension feeders, the high tension mains and the low tension mains. Six so-called nodal points, or points of distribution, are fed by six feeders, with four sizes of wire, namely 70, 100, 140 and 210 square millimetres. In the high tension mains only two sizes are employed, viz., 25 and 50 square millimetres, and in the low tension, or secondary, mains, 70 and 100, and, in rare instances, 140 square millimetres. Having in mind the expense entailed in laying underground wires,

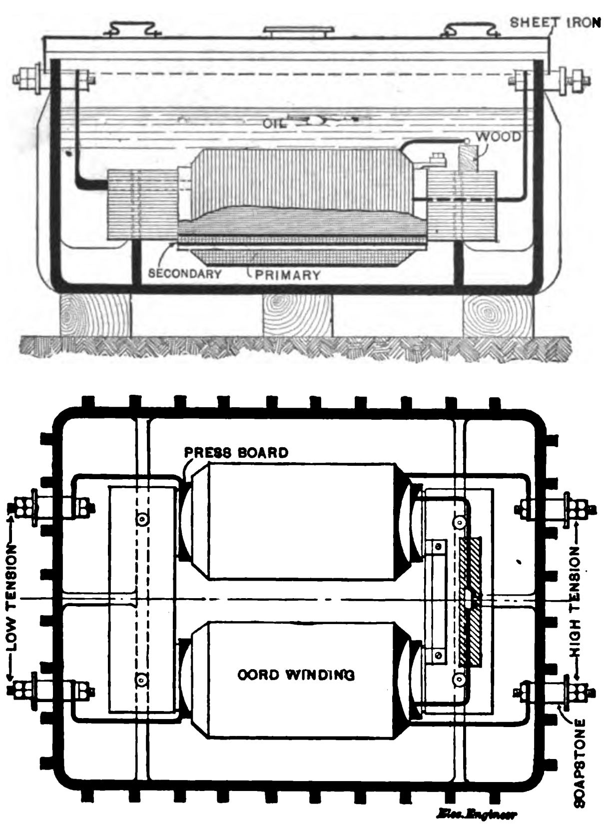

FIG. 4.—OIL INSULATED TRANSFORMER.

it was deemed wise to provide for future increase at once and to put down heavy conductors, which at the same time insure a good regulation of the pressure.

The cables are situated under the sidewalks close to the house fronts; at the street corners the conductors are placed in iron water pipes, which insures them against damage. The conductors laid in uninhabited streets are covered with iron plates. Within the city all the cables are laid in trenches 70 centimetres deep, imbedded in sand and protected from injury by a covering of brick. The high tension cables are placed at one side below the low tension cables, the latter always lying nearer to the side of the house, as shown in the diagram, Fig. 2. In all streets the conductors are laid on both sides, and their total length is 84,000 metres. Concentric asphalt-insulated cables are used, protected with iron ribbon armor; these were manufactured and laid by Messrs. Felten & Guilleaume, of Mulheim on the Rhine. No connection boxes are employed; the lengths were manufactured according to accurate dimensions and the absence of connection boxes gives the system a very high insulation, which is of special advantage for the 3,000 volt high tension cables.

IV.—THE TRANSFORMERS.

The high tension current is reduced by 90 transformers situated about 150 to 300 metres apart, delivering 110 volts to the low tension mains. The placing of transformers in every house requiring current had to be abandoned for many reasons. The original plan of installing the three-wire system with 220 volts had also to be abandoned, owing to its unpleasant physiological effects to those who might come in contact with it. This, of course, necessitated a considerable increase in the number of transformer stations.

The manner in which the transformers are housed is quite typical. The small iron columns placed in the streets, which have become so popular abroad for the housing of transformers had to be abandoned, both on account of the looks and also to avoid obstruction to traffic in narrow streets; thus the only way open was to place the transformers underground, and this was carried out in the following elegant manner. As shown in the illustration, Fig. 3, a pit of about 10 cubic metres capacity, was dug and lined with brick, laid in cement. At the bottom of this there is placed a cast iron box provided with a lock, in which the transformer lies, entirely covered with oil. Above the transformer comes a wooden floor covered with linoleum and in the remaining space, about 2 metres high, the switches and safety devices are arranged, and may thus be handled without danger. The pit is closed with a ribbed cast iron plate, over which the sidewalk level is re-established. A manhole with several ladder rungs admits of easy access to the pit.

The moisture accumulating in the pit is carried off by the strong ventilation, the necessary air circulation being effected by means of the heat given out by the transformer. In one case the air inlet took in air at 3.3° C., which left the pit at a temperature of 17.2° C. In this case 160 cubic metres of air had passed through the pit. This entire arrangement has proved excellent in practice.

The losses in the feeders are 4 per cent.; in the high tension mains, 1 per cent.; in the transformers 4 per cent. and the low tension mains 1.2 per cent. These figures relate to the maximum current consumption. They naturally fall to quite a small figure with the decrease from the maximum. Each transformer consumes 2 per cent. of its maximum energy when running free, due to the work of magnetization.

The regulation is effected by leading pressure wires back to the central station from several points in the low tension system. There can thus be measured at the station the potential of every single district of the city and the mean potential of the whole. It has been shown in actual practice that the difference in potential between the various parts of the city scarcely amounts to 1 per cent. With varying consumption the proper potential can be easily effected by regulating the excitation of the machines.

Up to the present time no disturbanaces worth mentioning have occurred, but from what has gone before, it will be understood that great care has been exercised in laying out the work. The total cost of the entire system was 2,500,000 marks, which amount did not exceed the original estimates; the entire work was finished within six months, and is a brilliant example of modern engineering.

ASPHYXIATE EM.

Mr. S. Davis, of Carson City, Nev., writes that mining operations show that a slight whiff of mine gas causes an instantaneous and painless death, and he suggests that the quiet application of gas would be a much better, nicer and cleaner way of killing criminals than the use of electricity. The idea is a good one and has already been advocated in these columns.

TELEPHONY.

THE CALLENDER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

STATISTICS show the general average of telephones in use at one time to be not more than twenty per cent. of the total number constituting the exchange. Whether this percentage be somewhat greater or less matters little, as it will be apparent that there will always be a considerable number of telephones in disuse in every exchange at any given hour of the day. Having in view this important point, Mr. Romaine Callender has devised what may be termed a percentage exchange system; that is, one which provides mechanism enough to do the estimated maximum business at any busy portion of the day. Instead of an individual mechanism for each subscriber, a percentage only of mechanisms is provided. The whole of these mechanisms are for the common use of all telephones in the system, provision being made by which a telephone subscriber on turning in a call to the exchange individualizes for his own use one of the common mechanisms not in use at the time his call arrives. It may be well to state here that, under any system, the complete act of operatively connecting any two lines together involves several steps. These steps may be enumerated as follows: First, signaling to the exchange the number of the telephone with which connection is desired; second, the interconnecting of the signaling line with the line called, and third, the signal from the exchange to both users, notifying them that their lines are connected. Several seconds are consumed in calling up or signaling to the exchange, further time is used in effecting the connection, and additional time is used for signaling to both parties when the connection is established. This involves three successive time elements, and a fourth time element exists for that period of time during which the lines are connected, *i. e.*, while talking is being carried on. It will be evident that if one mechanism is to perform the functions of receiving signals, interconnecting lines, signaling when connection is effected, and is also to be held while talking is being carried on, the full benefit of percentage use could not be had. A little consideration will make this clear. While it takes only a short time to effect a connection, the lines, when once connected, may remain in that condition for one or two minutes or more, depending upon the length of the conversation. A division

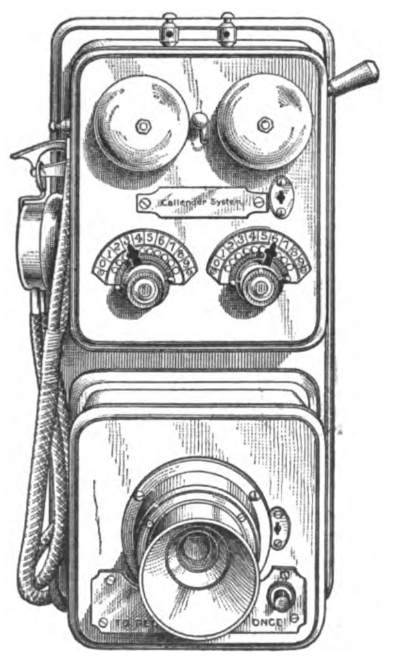

FIG. 1.—SIGNALING TRANSMITTER.

of the apparatus into signal receiving mechanisms, signaling mechanisms, connecting mechanisms, and mechanisms through which conversation may be obtained, allows of the full benefit of percentage use, as these mechanisms may exist in exact proportion to their use.

In a percentage exchange system the mechanisms for registering the incoming signals may be few in number, as they are only in use for a few seconds at a time. The mechanisms for connecting the subscribers and those for signaling to them, when connection is established, may be comparatively few in number, as these also are only in use for short periods of time. On the other hand, the mechanisms through which conversation is maintained must necessarily be more numerous, as they are in use for longer periods of time. The aim of the percentage system is to divide the telephone exchange apparatus into groups, proportioned to the length of time they will be in use when active; it being understood that as soon as the various mechanisms in the several divisions have performed their functions they revert instantly to common use. This allows many signals to follow each other in rapid succession over the same divisions of the system, in a manner somewhat analogous to the passage of trains over a railroad using the block system, where a large number of trains may be on the same line and yet no two in the same block. It will be well to add to this general statement of the percentage theory the

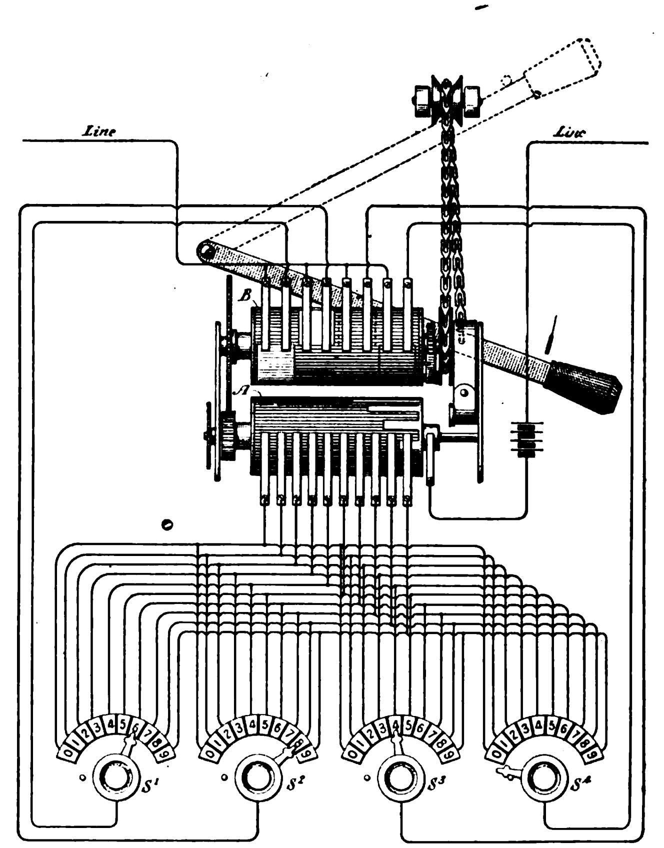

FIG. 2.—DIAGRAM OF SIGNALING TRANSMITTER.

explanation that the various divisions of the system are pluralized in proportion to their greatest estimated use, one division, for instance, that for receiving signals, having a proportion equal to the highest number of calls likely to be received during one fraction of a second—a difference of a second of time allowing one signal to pass on out of the way of the succeeding one. Provision is also made by which signals up to the estimated maximum number may arrive simultaneously without interference, and an additional resource in this respect consists in the receiving mechanism which stores up the incoming call for a short period of time, long enough to allow some portion of the system to fall into disuse, and thereby enable the stored call to become effective.

Before describing the electrical and mechanical features of the exchange apparatus, it may be well to refer to the apparatus at the subscriber's station, Fig. 1. This consists of a telephone transmitter, receiver, battery and call-bell, together with a signaling transmitter of special form. This signaling transmitter, Fig. 2, is provided with means for transmitting electrical impulses in series or sets to the exchange station. It consists of an insulated rotatable cylinder A carrying ten contact strips of varying length. Held against the cylinder are ten contact brushes. One of these is adapted to make electrical connection successively with each one of the contact strips on the cylinder, when the cylinder is rotated. Another of the contact brushes connects with only nine of the contact strips, while the next brush connects with only eight strips, and so on to the tenth brush, which makes electrical connection with only one of the contact strips. This circuit-making and breaking cylinder has electrical connection with a series of hand operated indicator switches, S_1, S_2, etc., located on the front of the signaling transmitter case.

Each of these switches is adapted for indicating any one of a series of numerals, 0 to 9 inclusive. The number of the switches is equal to the number of numeral places in the value of the highest numbered line in the system—that is to say, in a system of not more than two numeral places, up to 99, two switches are

necessary. In a system of three numeral places, up to 999, three switches are required, and so on. The impulse transmitting cylinder revolves as many times as there are indicator switches on the outside of the case. In a system of not more than 99 telephones the cylinder is caused to revolve two complete revolutions, together with an extra preliminary revolution for a purpose that will be described later. In a system of not more than 999 telephones it revolves three times. The preliminary revolution just referred to is for transmitting a preliminary impulse to the exchange station for the purpose of seizing some unused portion of the percentage apparatus; the succeeding revolutions being for transmitting the signaling impulses representing the thousands, hundreds, tens and units in the number of the telephone with which connection is desired.

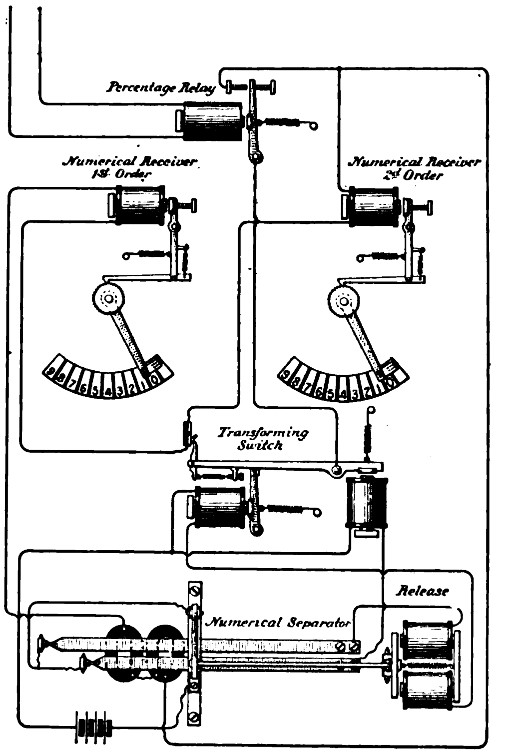

FIG. 3.—SIGNAL REGISTERING APPARATUS.

The mechanism of the signaling transmitter includes a controlling commutator B, Fig. 2, for changing the circuit through the several indicator switches in succession. To illustrate its working it will be necessary to suppose that a call is just being turned in for connection with some other telephone, say number 684. Three of the signaling transmitter indicator switches would be set in numeral order, from left to right, so that the left-hand switch would indicate 6, the middle switch 8, and the right-hand switch 4. The controlling commutator, by changing the circuit through the indicator switches from left to right successively for each rotation, causes impulses the equivalent of 684 to be transmitted to the exchange station. Although one of the indicator switches may be arbitrarily designated as the hundreds switch, and another as the tens, etc., it is not necessary that this should be done. The impulses as they arrive at the exchange are automatically classified into hundreds, tens, etc., in a manner to be described later.

The signaling transmitter is set in operation by a lever which projects from the side of the transmitter case. The lever when drawn down stores up energy in a coil spring. The coil spring operates a wheel train and fan, with which are connected the circuit-making and breaking cylinder and its controlling commutator. This controlling commutator revolves only once at each operation, but the circuit-making and breaking cylinder revolves as many times as there are numeral places in the value of the highest numbered line in the system, as has already been explained.

Before entering on a detailed description of the apparatus at the central station it will be well to outline the mode of operation. It will be remembered that in connection with the description of the signaling transmitter, mention was made of a preliminary impulse. Whenever a signal is transmitted to the central station, the preliminary impulse precedes it and causes the seizure and isolation of one of a number of connecting strips controlling access to mechanisms for registering the number of the telephone with which connection is desired. The signaling impulses, as they arrive at the exchange, are registered on one or more instruments designated "numerical receivers," Fig. 3. Each series of impulses, corresponding to hundreds, tens, etc., is registered on a separate receiver. In series with each group of numerical receivers is an instrument designated the "numerical separator," also shown in Fig. 3. The office of the separator is to distribute the different sets of impulses to their respective receivers, so that if a call is turned in, for say number 36, the separator divides the first set of impulses from the second, and causes them to be registered on two different receivers—the tens on one and the units on the other. An instrument known as the "numeralizer" now comes into play and totalizes the indications of hundreds, tens, etc., and then selects the circuit of equivalent numerical value. The signaling telephone is then connected to the telephone signaled for, and at the same time a copper ball, which has been released over a signaling track, runs along it by gravity and causes the call-bells of both subscribers to be operated, notifying them of their interconnection. Each of the foregoing divisions reverts to common use as soon as it has done its share in the making up of the complete connection; the connector only remaining in use during the time that conversation is being held over the connected lines.

Returning now to the apparatus at the central station, the construction and specific functions of the circuit selector will first be noticed.

The "percentage circuit selector," Fig. 4, consists primarily of a series of metallic conducting rings, insulated from each other and held concentrically on the same plane. Around each ring is arranged a series of armature-headed plungers. These plungers are normally electrically disconnected from the conducting ring, but are adapted to be moved into engagement with the ring under the influence of electro-magnets carried by revolving arms; each ring of plungers lying in the path of one of these electro-magnets. Each conducting ring represents a distinct percentage division, and each controls access to the mechanisms of its division. The plungers are terminals of branch conductors from each telephone line and they serve as connectors for establishing a circuit from a signaling telephone to the signal-receiving mechanism of the division seized and held for the time being by the signaling telephone. Fig. 5 shows the circuit selector diagrammaticaly and Fig. 6 a section of the apparatus in detail.

The branch conductor just referred to may be connected at will to any one of the conducting rings C through the instrumentality of the plunger P and the controlling electro-magnet O. It will be understood that one electro-magnet controls one ring of plungers, and the selection of any one plunger is governed by an auxiliary mechanism, about to be described. This consists of one or more revolving cylinders, or "isolators" carrying oblique contact strips. These strips are insulated from each other, and each strip has electrical connection through a commutator, with its corresponding electro-magnet revolving over its appropriate ring of plungers. Held against the revolving selector cylinder is a series of contact brushes representing terminals of branch conductors, adapted to complete a circuit through the selector under certain conditions to be described later. The cylinder and the revolving arms A carrying the plunger-selecting electro-magnets O are geared together and are revolved by a constantly operating electric-motor shown in Fig. 4. By this means the brushes against the revolving cylinder are brought into electrical connection with the oblique contact strips successively, and one at a time. As each contact brush engages with an oblique strip the arrangement is such that the plunger-controlling electro-magnet, electrically connected with the oblique strip, will be immediately over the plunger of that line corresponding to the number of the brush in engagement with the oblique contact strip. There are as many oblique strips on the cylinder as there are sets of conducting rings and plungers. The whole action of the preliminary impulse already referred to is to raise the plunger of the signaling line into electrical connection with some one of the conducting rings. As soon as this is done the circuit is so changed that no

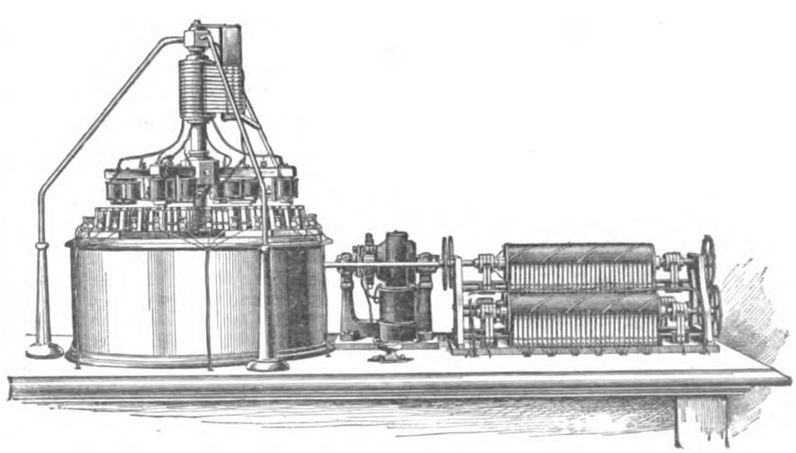

FIG. 4.—PERCENTAGE CIRCUIT SELECTOR.

other signaling telephone can obtain connection with the conducting ring just seized; the oblique conducting strip, although it will pass under other brushes representing lines over which signals are being received, will not be affected. Should two adjoining brushes be in condition to complete a circuit through a selector at the same moment of time there will be no interference, as the first unused oblique strip will be presented to one brush and become individualized to it instantly, while the next brush immediately following will not be affected until some other unused strip is presented to it. From this it will be noted that the effect of the preliminary impulse is prolonged for one complete revolution of the selector cylinder, so that should the greater part of the percentage system be in use at the time of the reception of such impulse, the rotation of the selector cylinder will eventually present an unused strip to the waiting brush.

The "progressive switch," Figs. 7 and 8 is one of a group of instruments controlled by the circuit selector. The preliminary impulse in seizing a percentage division for the reception of a signal, seizes at the same time one of the progressive switches. The seized division of the circuit selector, which is only used for a few seconds, soon reverts to common use, but the progressive switch remains individualized for the use of the signaling line, until the connection is established. As soon as this step has been effected the progressive switch also reverts to its normal condition, ready for use by any of the remaining lines. The action of the preliminary impulse translated through some one division of the circuit selector is to seize some one of the progressive switches, to individualize it to the signaling line, and in so doing to step the progressive switch forward one degree. This isolates the signaling line and prevents any other line from interfering with it in any way thenceforth until the progressive switch passes from under the control of the signaling line. The signaling impulses which now follow are registered on the receivers in a manner to be described later, and as soon as this registration has been effected the progressive switch is automatically stepped forward another degree. In this position the switch is connected to one of the signaling tracks, a description of which shortly follows. A constantly operating alternating current generator is then put in circuit with the signaling line, through the signaling track and progressive switch, for the purpose of ringing the call-bell at the outlying station; one long ring if connection is established, or two disconnected rings, a "busy" signal, if the line called for is in use. The progressive switch is then stepped forward another degree, leaving the connected lines in condition for telephonic communication, or if the line called for is in use the signaling line is placed in condition for turning in other calls. The switch is restored to normal condition either by the act of the signaling subscriber releasing, or by a time limit apparatus at the central station, where such apparatus is used. The foregoing action is that of a signaling subscriber using a progressive switch for the purpose of effecting a connection with the line of some other subscriber. These progressive switches work in pairs, the other switch being seized also by the signaling subscriber as soon as a registration has been effected of the number of the telephone with which connection is desired. The seizure of the second progressive switch individualizes it to the use of the telephone signaled for, and prevents any other telephone from connecting with it from that time until released. This seizure also puts the switch in condition for sending a call-bell signal over the line of the subscriber called. It is then automatically instrumental in establishing a talking circuit through an apparatus designated the "Connector," a description of which follows later. The circuits are so arranged that when a call arrives at the exchange for connection with a telephone already connected and in use, no progressive switch can be individualized to the use of the busy line until it goes into disuse. An automatic change is effected on the proper signaling track, representing the division in which the signal is registered, and as a result of this change a busy signal is sent over the line of the signaling telephone, while the busy telephone is left undisturbed.

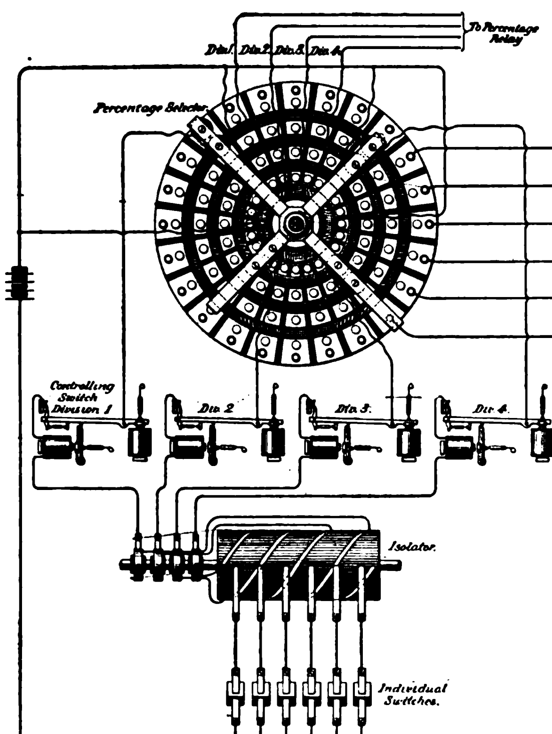

FIG. 5.—DIAGRAM OF PERCENTAGE CIRCUIT SELECTOR.

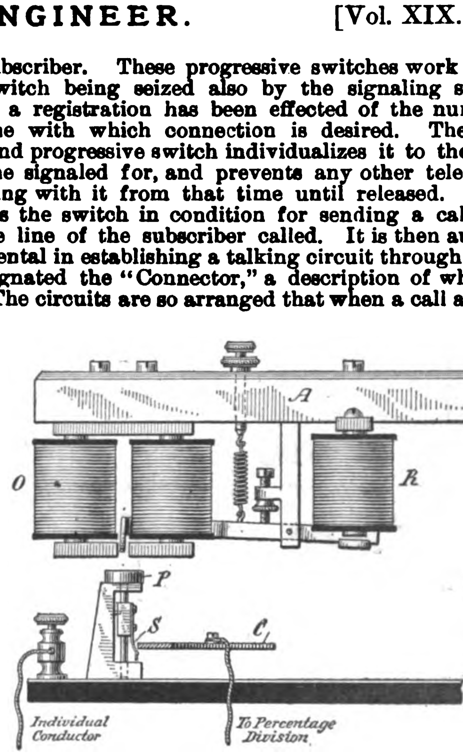

FIG. 6.—DETAIL OF CIRCUIT SELECTING APPARATUS.

The "numerical receivers" register the signaling impulses as they arrive at the exchange. They are assembled in percentage groups, the number of receivers in a group depending upon the number of lines in the system. In a system of not more than 99 lines, two numerical receivers are required in each percentage group. In a system of not more than 999 lines, three receivers form a group, and so on.

In the event of a signal arriving for connection with a three numeral place value, say 926, the receiver of the first order would register the first set of impulses, while the receivers of the second and third order would respectively register the second and third sets of impulses. In this event, the registrations of the receivers of the first, second and third orders would be respectively hundreds, tens and units. The receiver, Fig. 9, is a step-by-step apparatus of special construction for recording accurately the sum of the impulses received. It is adapted to take ten forward steps, corresponding to the numbers 0 to 9 inclusive.

The various series of impulses are distributed to their proper receivers by an instrument designated the "numerical separator." One receiver can register nine indications, two receivers can register 99 indications, while three receivers can register 999 indications. Each receiver directly controls ten fractional branch circuits, and the varying combinations are totalized or integrated by an instrument termed the "numeralizer."

A "numerical separator," is included in series with each group of numerical receivers. It consists of a controlling electro-magnet having two vibratory reed armatures as shown in Fig. 10. The reeds are adapted to be put into vibration for a predetermined length of time on the closure of a circuit through the controlling electro-magnet. These reeds have different vibratory periods. After being put into vibration by the first series of signaling impulses, the shorter reed first comes to a position of rest and closes a circuit for switching the succeeding series of impulses through the numerical receivers sequentially. The separator is normally in series circuit with the receiver of the first order, and its action, after each series of impulses, is to prepare a new circuit leading the next succeeding series of impulses to the corresponding order of numerical receiver. The longer vibratory period reed comes to a position of rest immediately after the shorter reed and closes a shunt circuit through a releasing device, which places the separator in condition for further use. It is necessary to state here that the signaling impulses are so controlled by the signaling transmitter at each subscriber's station that each series of impulses is separated from the succeeding series by a time interval. It is during this short time interval, of about two-fifths of a second, that the separator reed comes to a position of rest and closes the switching circuit, preparing a new path for the next series of impulses immediately following.

The "numeralizer," Fig. 11 is a compound switch for giving electro-mechanical effect to the combined indication of the several numerical receivers constituting a percentage group. It is put into operation after each complete signal has been registered. It combines the fractional circuits controlled by the numerical receiver indications of hundreds, tens, etc., and selects an integral circuit equal in numerical value to the sum of the combined indications. It is based on the theory of decimal control, aided by a system of transforming circuits, and its method consists in causing one circuit to control ten, a hundred, a thousand, or ten thousand circuits, by eliminating decimally all values of the thousands, hundreds, tens orders etc., not indicated by the compound registration of the numerical receivers.

The "signaling track," Fig. 12, consists of an inclined runway having two copper rails insulated from each other. On one side the rail is continuous, and acts as a feeder for current supply. On the other side the rail is broken into sections having electrical connection with various parts of the percentage apparatus. The arrangement is such that when a circuit-closing ball is discharged over the track it runs along it and closes circuits between the rails and the apparatus electrically connected thereto. Each percentage division of the system includes one signaling track. As soon as a call is registered in any division of the signal receiving apparatus a circuit-closing ball is discharged along the signaling being held. The apparatus contributing to the final connection has all reverted to common use, and the percentage connecting strip eventually becomes free for other users as soon as the conversation is terminated. Any of the connecting strips may be brought into operative relation with each of the subscriber's lines, the arrangement being such that when one is seized it is held by the signaling subscriber until he allows it to revert to common use by the transmission of a "release" impulse from his signaling transmitter.

The invention comprehends other features of novelty, such as the storing of calls for lines in use at the time of the call arriving, and an automatic recording system for registering the number of connections had by any subscriber. These are not necessary features of a percentage exchange system, but they are readily adapted for use with such when considered desirable. The call storing system acts as follows: When a call is received for connection with some other telephone then in use, that call is stored and a busy signal is sent over the line of the signaling telephone. The busy telephone is not interfered with until its user releases it from connection. As soon as this is done the stored call becomes effective, and a "connected" signal is sent over the lines of both parties to the new connection then made. Many calls may be stored for the same telephone. In adopting this feature it is not necessary to apply it to the whole system, as it may be used in

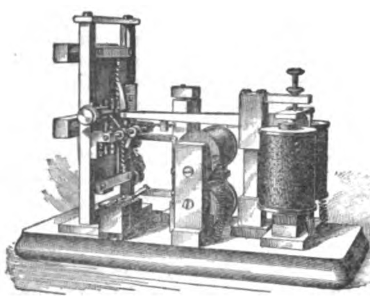

FIG. 7.—PROGRESSIVE SWITCH.

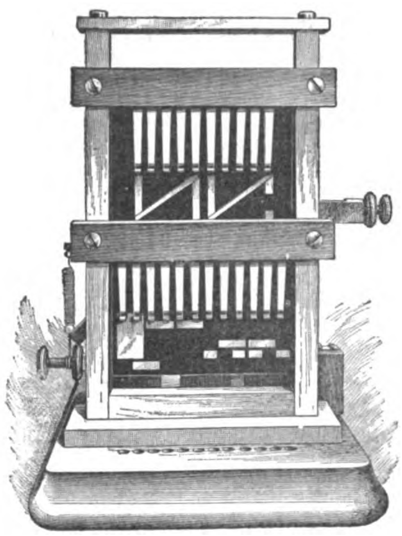

FIG. 8.—PROGRESSIVE SWITCH.

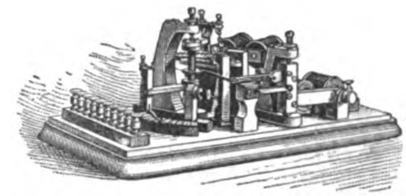

FIG. 9.—NUMERICAL RECEIVER.

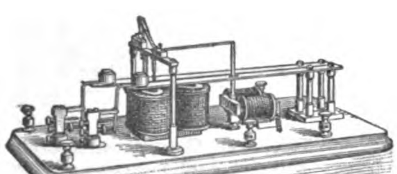

FIG. 10.—NUMERICAL SEPARATOR.

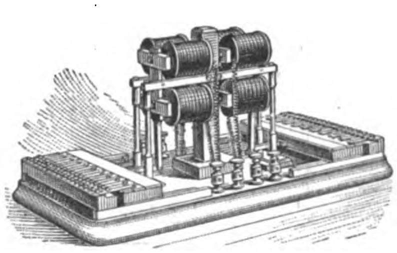

FIG. 11.—NUMERALIZER.

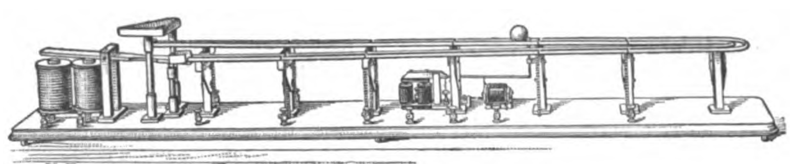

FIG. 12.—SIGNALING TRACK.

track of that division for the purpose of signaling to the calling subscriber a "busy" signal if the line required is in use. If connection has been established, it is made known by a long continuous ring on the call-bells of the connected subscribers. At that part of the signaling track where the circuit-closing ball is caused to ring the call-bells of the outlying stations, three disconnected sections of track are found. The electro-mechanical connections to these track sections are such that when a calling subscriber has signaled for connection with a telephone already in use, the second section of track is made neutral so that the circuit-closing ball will ring the call-bell or bells on only the first and third sections of track; the second or neutral track being utilized for causing a time element between the call-bell signals turned in by the passage of the ball over the first and third sections of track. On the other hand, if connection has been established, the three sections of track are converted electrically into one long section, so that when the circuit closing ball passes over the three sections of track a long continuous signal is caused to be sent over the lines of the two connected subscribers.

The "connector" is a counterpart of one portion of the circuit selector. It consists of a series of conducting strips pluralized on a percentage basis. By a process similar to the selection of the per centage connection for signaling purposes, the plungers of the calling and called subscriber are connected to one of the percentage strips, and left in that condition while communication is connection with any part or parts of the exchange. The same remark applies to the connection-recording apparatus; this can be used with any desired number of the lines entering the exchange. It is designed for those users who prefer payment for actual use, as in the toll system and, as the record shows the day of the month and hour of the day, it affords ready means for encouraging increased use of the telephone at reduced rates for those hours of the day during which exchange facilities are not in general use.

We may add that a model exchange equipped on the Callender system will soon be shown in operation in the Decker Building, Union Square, New York.

THE DECLINE IN BELL TELEPHONE STOCK.

A curious feature of the decline in American Bell telephone stock is pointed out by the Boston *Advertiser* as follows:—

It is figured by some that Bell might have dropped to 150 in some markets from such a legal setback as was had the last week, in which case the man who had realized 5c. from the sale of his right would have lost 20 times the amount by guaranteeing a subscription to the share capital at 190. Some stockholders made their subscriptions early, or when the stock was around 200, and applying at the office of the company to withdraw it, have been informed that their subscription could not be cancelled. Up to

the time of Judge Carpenter's decision about 700 shares of the 5000 offered had been subscribed for, and it does not seem reasonable to expect that the amount of Bell Telephone stock subscriptions will exceed 1000 shares. The law says the remainder must be sold thereafter by auction, but sets no limit of time, and the policy of the company as respects the future in this matter has not been officially determined.

TELEPHONE FRANCHISE ASKED FOR IN ST. PAUL. MINN.

The United Electric Corporation is the name of a concern which has applied for a telephone franchise in this city. An ordinance granting this company a franchise has already been drawn up and is likely to be submitted at any meeting of the board of aldermen. The United Electric corporation has headquarters in Minneapolis and the heads of the concern are Samuel Grant, son of Donald Grant of Faribault, John H. Finney and George R. Kibbe.

TELEPHONIC ACTIVITY AT BAY CITY, MICH.

Four telephone companies are trying to get a foothold in Bay City, and their representatives are nearly bothering the life out of the aldermen, so anxious are they to secure franchises. The latest company to ask for this privilege is a Cincinnati concern, at the head of which is Marcus O. Anthony, an old Bay Cityan, who is well known as an electrician. He offers to meet the prices of the other companies and guarantees the best possible service.

CHEAPER TELEPHONE SERVICE FOR LEWISTON, ME.

A special dispatch from Lewiston, Me., says: The people of Lewiston and Auburn, understanding that the patent on the telephone transmitter is made void, there has originated in Auburn a plan to form a co-operative telephone exchange, in order that local connections may be enjoyed at a lower rate than $3.50 a month, which is the current tariff here. It is proposed to do this or force the present company to lower its rates by presenting to the officials a list of subscribers who are expected to abandon the company and patronize the co-operative exchange.

TELEPHONE WAR IN KNOXVILLE, TENN.

The People's Telephone and Telegraph company at Knoxville, Tenn., has completed a new exchange with 500 subscribers. The new company enter the field against the East Tennessee Bell Telephone company. The new company furnishes telephones at half the rate of the old company, who say they will not be run out of business if they have to furnish free instruments.

TELEPHONY NOTES.

NEWARK, O.—Messrs. Brennan and Stevens are laying out the pole lines for the new telephone company just incorporated.

SHAMOKIN, PA.—The Shamokin Valley Telephone Company has been formed with a capital of $12,000.

DUNKIRK, N. Y.—The Phœnix Telephone Company will soon commence the construction of a system.

THE CHICAGO TELEPHONE Co. is erecting a new small sub-exchange, on Forty-fifth street, the building to cost $9,000.

GREENBURGH, N. Y.—H. O. Reed, of Bath Beach, and others, have formed the Greenburgh Telephone Co. with a capital stock of $20,000.

CARTHAGE, MO.—One hundred and fifty new telephones will be placed in this city by the Phœnix National Telephone Company. An exchange will be established.

CARTERVILLE, MO.—Carterville and Webb City are both taking kindly to the new telephone system the Phœnix Co. propose to put up.

INDEPENDENCE, KAN.—The Missouri and Kansas Telephone Company will put in a telephone exchange at Independence provided twenty-five yearly subscribers are assured.

ALTON, ILL.—J. T. Taubold, Superintendent of the Bell Telephone Company, with a force of men, is engaged in erecting a new telephone line between Venice and Alton, Ill.

BAY CITY, MICH.—The Bell Telephone Co. is placing itself in a position to combat encroachments of other companies in this territory by improving its system.

LOCKPORT, N. Y.—The Bell Telephone Company has been notified to take its wires and poles from this city by the Common Council. The company refuses to reduce rentals.

CHESANING, MICH.—The Flint Electrical Company have just completed the magneto-electric telephone plant they have been placing in the village.

MIDDLEBURY, VT.—The People's Telephone Company has set up an exchange at St. Albans and furnishes telephones at $10 to $15 a year as against $45 charged by the old company.

BROOKLYN, N. Y.—The aldermen have granted permission to the New York & Eastern Telegraph & Telephone Co. to string its wires upon the poles of the Fire Department. The company was recently granted a franchise over Mayor Schieren's veto.

FT. PLAIN, N. Y.—The Interstate Telephone Company will establish a central office here. Connections will be made with the following towns: St. Johnsville, Canajoharie, Little Falls and Dolgeville.

PHILADELPHIA, PA.—The Bell Telephone Company proposes to establish five new telephone exchanges, at points in the city that will give the concern a headquarters in nearly every section of Philadelphia.

ROCK HILL, S. C.—J. G. Anderson and A. E. Smith have secured powers for the organization of the Rock Hill Telephone Co. The capital stock of the company is to be $5,000. Franchise was obtained recently.

BURLINGTON, IA.—The new telephone company that proposes to build a line from Burlington to Columbus Junction via Wapello, and from thence northward to connect with the toll lines running south of Cedar Rapids, has begun active work.

RICHMOND, VA.—The Board of Aldermen have concurred in the action taken by the Common Council revoking the franchise of the Southern Bell Telephone Company in Richmond. If the Mayor approves this action all rights of the company in Richmond will cease in one year.

DAYTON, O.—A communication has been received by the local authorities from the Anthony Electric Company by M. O. Anthony, petitioning the B. C. A. for a franchise to erect poles, string wires and all that is necessary to the operating and maintaining of a first-class telephone exchange.

QUOGUE, L. I.—A new enterprise has taken form in the shape of a telephone line between Riverhead and Quogue, East Quogue and Westhampton. The work is being done by the Perkins Brothers and parties on the south side. It is supposed the line will be in operation in January.

ITHACA, MICH., has organized a stock company with $5,000 capital, under the name of the Gratiot County Telephone company, with the purpose of connecting with every village in the county. Hundreds of farmers have signified their purpose to connect with the lines.

ANDERSON, IND.—The American Telephone Construction Company has been organized and incorporated at Anderson and officers elected: President and treasurer, C. M. Harriman; secretary, F. W. Bradbury; general manager, R. H. Cokefair, recently of the Central Union Telephone Company. The new company will put in the American electric telephone system. Plants are to be erected at Lebanon, Bluffton, Noblesville and Laporte.

BROOKLYN, N. Y.—The Law Committee, which was authorized by the Board of Aldermen to investigate the franchise of the New York and New Jersey Telephone Company, which operates in this city, has reported that the company had never been granted a license. It was discovered, however, that the company came into existence under what is known as the "Telegraph Act," and was granted permission by the Legislature to begin operating in 1883.

DETROIT, MICH.—The Harrison Telephone Co. of Michigan will offer telephones for residences in Detroit at $36 a year. It will be readily understood that one of the hardest things that the new company has to fight against is the fact that the old company has an exchange already established containing all telephone subscribers in the city. Users of telephones would be slow to subscribe to the new company's exchange unless they had the assurance that most of those with whom they could talk over the old lines were to be taken in by the new concern. It is given out that the Harrison company will not put in a telephone in Detroit unless they can secure at least 4,000 subscribers, and it is to find out how many they can get that agents have been sent out. It is understood that the city rates offered are $40 or $50 for business places, according to their location.

AID FOR STUDENTS.

A circular has just been issued by Columbia College drawing attention to the fact that many college students of ability but of limited means, would like to serve as assistants to professional men, or others, as a means of paying their way through college. With the facilities which the College offers for research and reference, there ought to be an opening for many such deserving students at the side of engineers and other professional men. Profs. F. R. Hutton and E. R. A. Seligman, Columbia College, 49th St. and Madison Ave., can give full information to intending employers.

THE TELEPHONE PATENT SITUATION.—MORE SUITS.

Referring to suit recently brought by the Western Electric Co. against the Citizens' Mutual Telephone Co. of Decatur, Ill., which company uses Harrison telephones, readers of THE ELECTRICAL ENGINEER will doubtless be interested in perusing the claims of the several patents upon which this company is sued; covering, as they do, a great number of familiar forms of switchboards. The first patent sued upon is that of Watson, April 16, 1882, 202,495, the claims of which have already appeared a number of times in THE ELECTRICAL ENGINEER. The next patent sued upon is that of Eldred & Durant of August 30, 1881, No. 246,481, the claims of which are as follows:

1. The combination, substantially as herein set forth, of a series of telephone-lines radiating from a central or exchange station to and connecting with a corresponding number of sub-stations, a series of spring-jacks, one for each line, which are normally held in contact with an earth-plate common to all the said lines, and a flexible connecting conductor, provided at each end with a wedge, having one of its faces of conducting and the other of insulating material.

2. A flexible connecting conductor, constructed substantially as described, having each of its terminals provided with a wedge, each of said wedges having one face of conducting and the other of insulating material, as set forth.

3. The combination, substantially as herein set forth, of a series of telephone-lines radiating from a central or exchange station to a corresponding number of sub-stations, a series of spring-jacks, one in each line of the central station, for the insertion of a telephone, and a second series of spring-jacks, one in each line, for the insertion of one terminal of a flexible connecting-cord, whereby any two lines may be coupled together and a telephone included in the circuit at the central station at the same time.

The next patent is that of No. 247,199, the claims of which are as follows:

Patent No. 247,199, September 20, 1881, M. G. Kellogg.

1. The combination of normally closed ground-circuits with switches, one switch for each line, and annunciators, one annunciator in each line between the switch and the ground-connection, and a pair of cords or plugs, and a clearing-out annunciator and keys, one key for each cord and one key or its equivalent for obtaining a derived circuit, whereby the ground and respective annunciators of any two lines may be cut off and the circuits of said lines diverted from the switches through the clearing-out annunciator, and the listening operator enabled to determine whether the subscribers have stopped talking.

2. The combination of normally-closed ground-circuits with switches, one switch for each line, and annunciators, one annunciator in each line between the switch and the ground-connection, and a pair of cords and plugs, and a clearing-out annunciator and keys, one key for obtaining a ground-circuit through the telephone, and means for signaling, whereby the ground and respective annunciators of any two lines may be cut off and the circuits of said lines diverted from the switches through the clearing-out annunciator, and the listening operator be enabled to signal to one of the lines, or to determine whether the subscribers have stopped talking.

3. In a telephone exchange, two lines connected together for conversation, in combination with a key for grounding the lines through the central-office telephone, and key *i*, whereby the lines may be disconnected and one of them closed to ground through the signaling-battery, as and for the purpose set forth.

4. In a telephone-exchange, two lines connected together for conversation, in combination with two keys, one for each line, either of which, on being depressed, disconnects the lines and grounds its own line through the central-office signaling-battery.

5. The combination of normally-closed ground-circuits with switches, one switch for each line, and annunciators, one annunciator in each line between the switch and the ground-connection, and a pair of cords and plugs, and a clearing-out annunciator, whereby when the plugs are inserted in the switches which belong to any two lines their annunciators are disconnected from the lines and the lines connected together through the circuit of the clearing-out annunciators, substantially as set forth.

6. In a telephone-exchange, two lines connected together for conversation, in combination with two keys, one for each line, either of which, on being depressed, disconnects the lines and grounds its own line through the central-office signaling-battery, and a third key, which on being depressed grounds the lines through the central-office telephone.

Also patent of Horace H. Eldred of August 19, 1884, No. 303,714, which has the following claims:

1. The combination, substantially as hereinbefore set forth, of a series of telephone lines converging to a central or exchange station from different sub-stations, a series of spring-jacks—one for each line—for the insertion of connecting-wedges, and a series of visual signals or calling annunciators, W^1, W^2, W^3, W^4, W^5, W^6, one of which is placed in each line at a point between its spring-jack and the earth, whereby the annunciators are cut out while talking.

2. The combination, substantially as hereinbefore set forth, of a series of telephone lines converging to a central or exchange station from different sub-stations, movable switches and conductors 7, 8, etc., at said central station, whereby direct communication can be established between any two sub-stations by connecting both their respective lines together, and an auxiliary or supplemental signaling apparatus, R^1, etc., included in each of said connecting-conductors, whereby the sub-stations so connected, or either of them, may notify the attendant at the central station to disconnect the said lines.

3. The combination, substantially as hereinbefore set forth, of a series of telephone-lines converging to a central or exchange station from different sub-stations, movable switches and conductors at said central station, whereby direct communication can be established between any two sub-stations by connecting their respective lines together, a spring-jack in each of said connecting-conductors, an apparatus for transmitting and receiving calls or signals, and telephonic apparatus included in a loop which is provided with a wedge for insertion into said spring-jack, and a circuit changer whereby said loop may be divided and the leg containing the signaling apparatus and telephone connected directly with the earth.

4. The combination, substantially as hereinbefore set forth, of a switch-board, an auxiliary table, telephonic or electric apparatus located upon said table, and devices for establishing temporary electrical connection between one or more lines centering in said table, communication between sub-stations and the central station or between different sub-stations being established through the table apparatus.

5. The combination, substantially as hereinbefore set forth, of a series of visual indicators at a central station, a series of independent sub station lines converging to said central station, each passing through its respective indicator, and thence to a normal connection with an earth common to all of said lines, an operator's table, and devices for temporarily disconnecting one or more of said lines from the earth and simultaneously connecting them with said table.

6. The combination, substantially as hereinbefore set forth, of a series of sub-station lines converging to a central station, a series of conducting bars or strips permanently connected with an operator's table, and devices for temporarily connecting one or more of said lines with said bars or strips.

7. The combination, substantially as hereinbefore set forth, of a series of sub-station lines converging to a central station, a series of spring-jacks—one for each line—a series of conducting bars or strips, and flexible conductors armed with suitable plugs or terminals for temporarily establishing electric connection between one or more of said lines and said bars or strips.

8. The combination, substantially as hereinbefore set forth, of a series of sub-station lines converging to a central station, a series of annunciators or indicators—one for each line—a series of spring-jacks—one for each line—a series of conducting bars or strips, and flexible conductors armed with suitable plugs or terminals for temporarily establishing electric connection between one or more of said lines and said bars or strips.

9. The combination, substantially as hereinbefore set forth, of a series of sub-station lines converging to a central station, a series of conducting bars or strips, a series of branch or loop circuits, each uniting a single pair of said bars or strips, and means for forming a temporary electrical connection between any two lines and a pair of bars or strips.

10. The combination, substantially as hereinbefore set forth, of a series of conducting bars or strips, a series of branch or loop circuits, each uniting a single pair of said bars or strips, a series of spring-jacks—one on each branch or loop circuit—a telephonic apparatus, and a flexible conductor armed with a suitable terminal plug for connecting said apparatus with any of said branch or loop circuits.

11. The combination, substantially as hereinbefore set forth, of a number of spring-jacks, a plug for insertion into said spring-jacks, a switch, central-office instruments, and connections from said instruments to the points of said switch.

12. The combination, substantially as hereinbefore set forth, of a series of sub-station lines converging to a central station, an operator's table, devices for temporarily connecting one or more of said lines with said table, an electric generator, and key and switch mechanism upon said table for connecting said generator and key with any of the lines connected with said table.

13. The combination, substantially as hereinbefore set forth, of a series of indicators with a series of corresponding springjacks, each indicator being placed in proximity to its respective spring-jack.

14. The combination, substantially as hereinbefore set forth, of one or more operator's tables, one or more indicators, and controlling mechanism therefor located upon said tables.

15. The combination, substantially as hereinbefore set forth, of a series of independent lines or conductors, one or more branch or loop circuits, one or more central-office instruments, means for uniting any two of said lines or conductors with each other through one of said branch or loop circuits, and means for switching one or more central-office instruments into or out of such branch or loop circuit.

16. The combination, substantially as hereinbefore set forth, of a series of main lines coverging to a switch at a central station, devices for uniting any two of said lines for oral communication, apparatus included in each line at the central station to indicate a call or signal, and independent devices for connecting either line to a pole-changing apparatus for transmitting outgoing signals.

And lastly the patent of C. E. Scribner, November 10, 1885, No. 350,058, the claims of which are:

1. The combination, with a pair of cords and terminal plugs, of a subscriber's switch, in which one of said plugs is inserted, a telephone in a circuit, extending to a ground-connection from a connecting-piece common to the circuit of said telephone, and to the other of said pair of plugs, whereby connection is maintained from said subscriber's switch with the telephone, said connection being broken when said other plug is lifted from the common connecting-piece.

2. The combination, with the switch-board of a telephone-exchange, of a pair of plugs and flexible cords, one of said plugs being adapted to be inserted in a switch upon the switch-board, while the metallic portion of the other plug remains in contact with the common connecting-piece of the operator's telephone, said telephone being placed in the circuit between said common connecting-piece and the ground at the central office, whereby the circuit is closed through said telephone, substantially as and for the purpose set forth.

3. The combination of pairs of plugs each provided with a metallic portion, said portions being adapted to be held in contact with a common connecting-piece by means of weights, conducting cords, and the telephone-switches upon the switch-board, whereby when one of a pair of plugs is inserted in a switch the line of said switch will be connected through the operator's telephone, said telephone being disconnected automatically when the other plug of said pair is raised to be inserted in a second switch.

The policy of the Western Electric Co. seems to be to prosecute vigorously not only all manufacturers, but all users of any apparatus alleged in any way to infringe the vast number of detail patents owned by that company; it would also seem that these patents are selected simply in the order of the date and with reference to their application to the alleged infringing apparatus, and with less reference to whether they are likely to be sustained or not.

It would further seem that claim 15 of the Eldred patent covers any kind of listening key or switch that makes or breaks contact with any connecting cord, or any device which introduces the operator's instrument in circuit with the cord. It would also seem, if the patent of Eldred & Durant should be held to be valid, that the old-fashioned flat plug insulated on one side, when used in connection with a telephone switchboard in the ordinary way, will not be free until 1898, notwithstanding the expiration of the Cheever patent of October 1, 1878, which broadly covers substantially the same thing. It would also seem by referring to the Eldred patent of 1884, that any "clearing-out" drop which may be included in the connecting cords—no matter how included—is also presumably an infringement (see claim 2).

Information also reaches us that on January 3rd the Western Electric Co. brought suit against the Harrison International Telephone Co. for the alleged infringement of Watson patent No. 270,522 of January 9, 1883, upon Gray, No. 309,617, December 23, 1884, and also upon Scribner, No. 287,873, November 6, 1883. The Gray patent appears to cover any form of dynamo or magneto generator in which a shunt around the apparatus is automatically opened when the armature is rotating, and is automatically closed when the armature is at rest. The Scribner patent covers a particular organization of crank, lever and spring by which this result is obtained.

The annual report of the Connecticut Railroad Commission comes out strongly against allowing electric roads to cross steam roads at grade, and says it ought to be prohibited.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XIX. NEW YORK, JANUARY 9, 1895. No. 349.

CONTENTS.

AUTOMATIC TELEPHONE EXCHANGES.

WITH the telephone receiver entirely open to general use and a strong probability of the transmitter being free of further tribute from the public at large, one may expect in the near future a growth in the telephone industry; indeed the activity is already sufficiently marked to warrant the belief that it will assume proportions larger even than were anticipated. We note the first fruits of this activity in the increased number of private lines running for short distances and more particularly in house and office telephones for "speaking tube" purposes. But the many small towns and villages still unsupplied with telephone exchanges offer a field which is not to be despised and at which not a few have for a long time been casting envious glances. On the other hand, there are indications that competing companies will soon be bidding for business in cities already provided with exchanges, and that they will solicit patronage on the basis of service at lower rates than those now prevailing. That the managers of existing exchanges are not slow to appreciate the situation of affairs is evident by the recent reductions offered by the telephone companies in New York, Buffalo and other places, which we believe to be the outcome of a policy that is to be commended in every way and the fruits of which will soon be seen in a gratifying increase in the number of subscribers in those cities. The reduced rates, whether offered by new companies or by the old will of course call for the strictest economies in operation, and the question will now more than ever arise how to give a cheap service and at the same time a quick and reliable one. So far as the lines and outside work generally is concerned, an increase in the number of subscribers will call for a corresponding increase in the expense of maintenance of the system. Hence any reductions to be effected must be looked for within the exchange itself. In large exchanges, the wages of operators constitute a principal item of operating expense and it is in this direction that we may look for the first attempts at a solution of the cheap service problem. As an example we may cite the automatic switchboard, an alluring problem indeed, the solution of which has been attempted in an endless variety of ways. The mere substitution of human agency by mechanism, whether it be for cutting shoe pegs or connecting telephone subscribers, reduces itself to the simple question of cost, and by this test the automatic exchange must stand or fall. Mr. Callender estimates that an exchange equipment on his system, described in this issue, can be installed for $7 per subscriber, which is certainly a low figure when compared with the cost of some of the large switchboards now in use. But it is in the saving in operators' wages that he claims the principal advantage for his system. When we consider exchanges, for example, with from 50 to 75 operators averaging perhaps $9 per week each, the magnitude of the running expense of telephone exchanges becomes apparent, and it explains the continued attempts to avoid the necessity for operators. Ingenious as the Callender system is, it is too much to hope that it will be substituted for existing switchboards in large exchanges, if for no other reason than the reasonable reluctance of business men generally to discard costly apparatus for new

and still untried methods. But on the other hand if the system can do what is claimed for it, we see no reason why it should not find adoption in that large number of towns where the list of subscribers cannot exceed one or two hundred and where it might pay a fair dividend on the estimated investment. This field alone, if worked intelligently, will give the promoters of automatic exchange systems enough to keep them busy for a long time to come, and the success once established in the smaller work will be the most powerful aid they could desire towards the securing of more pretentious work.

FIGHTING PARALLELS.

The ability of electric railroads with cars running at frequent intervals to compete successfully with parallel steam roads is now a fact so well established as to require no further demonstration. Some steam roads have recognized this already, and as a result we have chronicled several instances in which local trains have been wisely abandoned as unprofitable. It seems, however, that the parallel electric railway is not to enjoy its newly acquired popularity undisturbed. Indeed, indications are already manifesting themselves that the steam roads will make a fight to maintain their traffic. This fact is showing itself in various ways. Thus we notice that the Cumberland Valley R. R. between Harrisburg and Mechanicsburg, Pa., where preparations are being made to build an electric line, has put on additional trains and is now running ten each way daily. It is also rumored that the fares will be reduced if necessary to retain the business. We cannot but admire the grit of the railroad managers in attempting to maintain their grasp on the business acquired and long held, but we confess our inability to see how they can long maintain such a warfare, which must in the end result disastrously to them. The moment they stop their unprofitable work, the trolley will step in. From whichever side we view the situation the electric road has the advantage. It can certainly run more cars at more frequent intervals than the steam road can with economy ; while on the other hand, the more trains the steam road runs, the less probably will be the economy of operation for that particular section, with a traffic such as is to be expected on that stretch of road and many others similarly situated. The reduction in fares proposed is sure to stimulate traffic, but there is a limit to this, as more than one rate-cutting road has found to its sorrow long ago. That steam railroad managers, who watch the course of events and know how to draw conclusions from them, are convinced of the futility of competing with parallel electric roads for local traffic, is indeed shown in the recent action of the Pennsylvania R. R. Company, who have brought suit at Lancaster, Pa. against the Lancaster & Lititz Electric Railway Company and the Lancaster Construction Company. The steam road avers that the electric road is séeking to run across a farm owned by the plaintiffs without their consent and without giving proper compensation for the right of way. This is obviously a subterfuge as the bill of complaint further claims that the Act of May 14, 1889, does not authorize the construction of railroads other than such as are necessary to "provide a cheap and convenient road for the carriage of passengers in the centres of population and business." The complaint requests the Court to restrain the issuing of certificates for the capital stock or bonds, and from crossing the plaintiffs' property, and that all securities already issued by the electric railway company be declared null and void and cancelled. We cannot believe that the officers of the Pennsylvania R. R. Company really expect to gain their point so far as the total extinction of the proposed electric railway is concerned, and the suit has probably been brought more with the view to delaying and embarrassing the work of rivals, a method of warfare in which steam roads are past masters. As we have had occasion to say in a recent discussion of this subject, the most satisfactory way to provide for the inevitable coming of the trolley for local traffic is for steam roads to build their own trolley lines, or re-equip existing tracks electrically, and the sooner they do so the better they will be off. We already note a growing tendency of state railroad commissioners to protect steam roads, among the more recent actions being the refusal of the railroad commissioners of both Connecticut and New York states to permit trolley crossings of steam railroads at grade. This cannot fail to give the steam roads equipped with the trolley an advantage, which will make competition from parallel roads more difficult; but unless they equip with electricity even this obstacle put in the way of competing trolley lines will avail them nothing.

The situation is an interesting one in many respects and the close of the episode will be watched with keen interest.

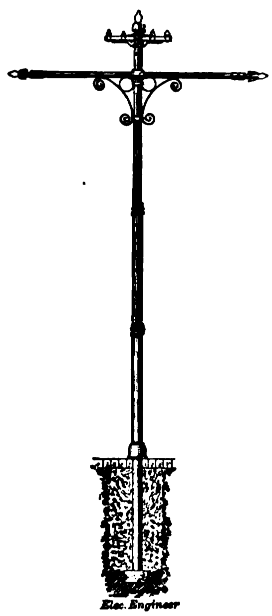
THE FRANKFORT CENTRAL STATION.

WE print in this issue a description of the central station recently started in operation at Frankfort on the Main, Germany, which, we believe, is worthy of more than ordinary study by all interested in electrical distribution. The station may be considered to be the result of more than ten years of agitation and investigation, and, indeed, was the direct incentive for, as well as the outcome of, the Frankfort Electrical Exhibition of 1891. With all the systems proposed and those shown in actual operation at Frankfort in evidence, before choice was made, the installation of the present plant at Frankfort must be considered a strong endorsement of the single-phase alternating system. The commission which finally decided upon the installation of this type of distribution made an exhaustive series of tests and came to the conclusion that the single-phase offered advantages sufficient to compensate for all drawbacks which had been brought up against it, especially that relating to its application to motors. The manner in which the station and the outside work has been carried out is worthy of the highest praise. The underground system, particularly, seems to have been worked out with great care, and, though the expense incurred was probably greater than would have been required had other more generally employed methods been adopted, we believe that the money will prove to have been wisely spent. The Frankfort central station must be considered out of the ordinary, so far as Germany is concerned, where storage batteries seem to have swept everything before them ; but in the present case the special conditions involved, including the long distance of the station from the centre of distribution, probably decided the day in favor of the alternating current.

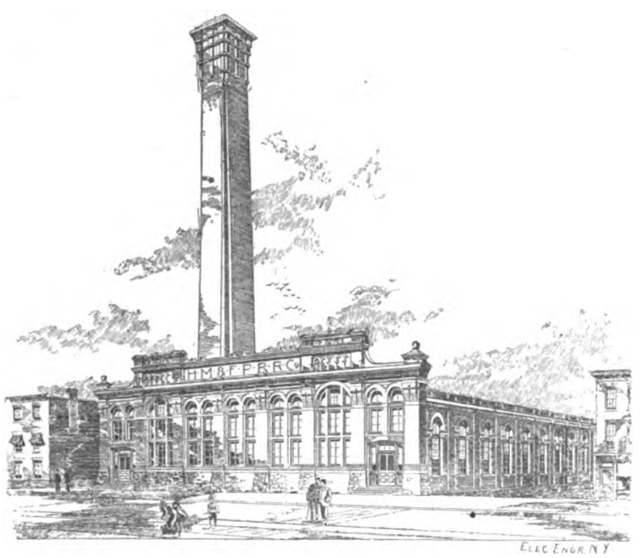
ELECTRIC TRANSPORTATION DEPARTMENT.

THE HESTONVILLE, MANTUA & FAIRMOUNT PASSENGER RAILROAD COMPANY.

I.



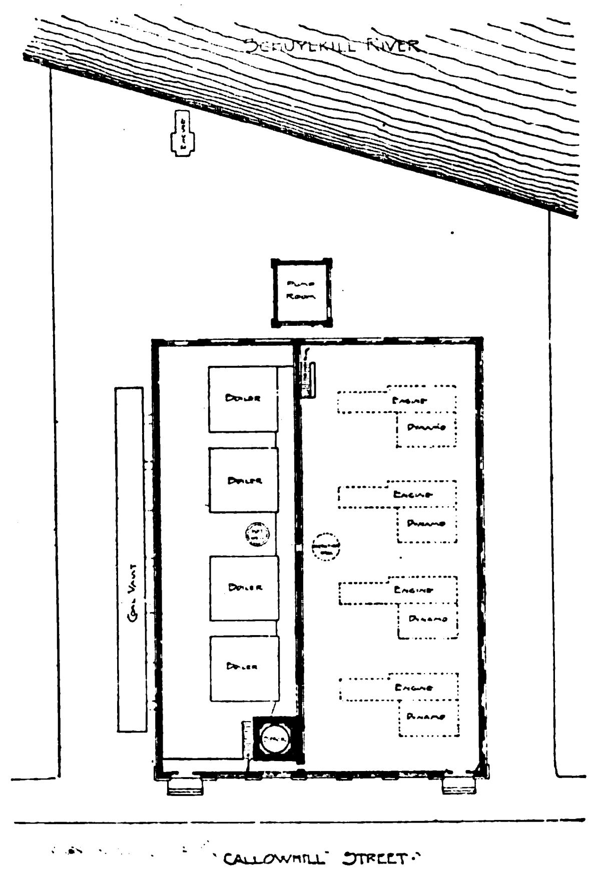
THE ringing of the Liberty bell over a hundred years ago hardly excited old Philadelphia more than the passage of the electric railway ordinance aroused the modern city in March, 1891, when the council after a long and stormy debate granted the street railway companies permission to use the trolley on the city streets. The newspapers outvied each other in scare headlines denouncing the deadly trolley and the calamity howler was abroad in the streets. The railway companies, however, were quick to see and grasp the advantages offered to them, and at once set about to equip their lines in a manner unsurpassed anywhere in the country. Among these was the Hestonville, Mantua and Fairmount, Passenger Railroad Co. whose lines consist of a consolidation of several roads running from the Delaware river across the Schuylkill to the western city limits, traversing some of the principal thoroughfares and entering Fairmount Park at three points. The directors of this company, realizing the value of their property if properly improved, at once set about putting the road in condition to handle the business that they felt sure would follow. The spring of 1893 saw everything in shape to commence the work of making the change, and in the following July, Mr. A. Langstaff Johnston was retained as chief engineer. He immediately selected a corps of assistants and started the work of preparing plans and estimates so that all contracts might be let in the following spring. Since then the work has gone rapidly forward, the main lines are now running and extensive additions are projected. The equipment—



The Power House.

both electrical and mechanical—is such as to demand special mention and cannot fail to be of interest.

The company, in the first place, was exceedingly fortunate in securing an almost ideal site for the power house. This is at twenty-fifth and Callowhill streets on the Schuylkill river, practically in the centre of the system and at a point where coal can be handled and water obtained for condensing with the greatest convenience and least expense. The building is shown on this page. It has a frontage on Callowhill street of 112 feet and runs back toward the river 150 feet. The front is of Pompeian brick, ornamental in design, while the side walls are of plain red brick laid in cement mortar. The foundations are exceptionally heavy. The front wall rests directly upon the bed rock which slopes rapidly toward the river, so that it was necessary to drive piling for the rear wall, the rear ends of the side walls, and one engine foundation. The foundations for the other engines are built up from the rock with rubble laid in Portland cement. The piling referred to is driven to the rock, cut off at low water mark and



Ground Plan of the Power House.

covered with two feet of concrete, on which the foundations are laid. Chas. McCaul of Philadelphia was the general contractor.

II.

The engine room is 150 feet long, 64 feet wide and will contain, when its equipment is complete, four tandem compound Greene engines built by the Providence Steam Engine Co. At present but two are in use, while another is being put in place. These engines make 100 revolutions per minute and have a maximum rated capacity of 750 H. P. They are connected directly with the generators and have fly wheels 18 feet in diameter.

The main steam piping is of extra heavy wrought iron with rivetted cast steel flanges and is carried on brackets inside of the engine room. The brackets also support a walk from end to end of the room from which a bird's-eye view of the machinery may be had. By-pass gate valves are located so as to cut off the boilers or to cut the main up into sections and in the branch pipes from the main to the engines are placed stop valves worked from the floor by cords in case of emergency. These valves can also be operated by the engineer in charge from his office. As an additional precaution, in case of accident, the engines may be instantly shut off by lifting their governor rods.

It will be noticed that no travelling crane is mentioned as a part of the power house apparatus. The reason of this is simply that the expense of a crane with a span of 64 feet (the width of the room) would have been very great and was considered useless under the circumstances. The machinery, including the 15-ton armatures, was all put in place with the aid of two gin poles and tackle without difficulty, and for future repairs a Johnston portable

hoist, made by the Car Equipment Co. of Philadelphia, will be used. This device consists simply of a wrought iron A-frame mounted on wheels. The wheels are provided with holes for crow bars and the frame can thus be moved from place to place with ease. While perhaps not so quick in its movements as an electric travelling crane, it has been found to answer all requirements in power stations, and has shown itself an exceedingly useful and economical piece of apparatus.

Dean condensers are situated under the floor, but in full view of the attendant, the floor being cut away for that purpose. Each pump takes its water from a well situated in the middle of the building and near the division wall between the engine and boiler rooms, shown on this page, and supplied with water from the river by a duplicate set of Worthington pumps with a 12 inch main. These pumps having a capacity of 20,000 gallons per hour, are situated in a handsome pump house in the rear of the power house. The discharge goes into the hot well in the boiler room, which has a 16 inch overflow into the river.

III.

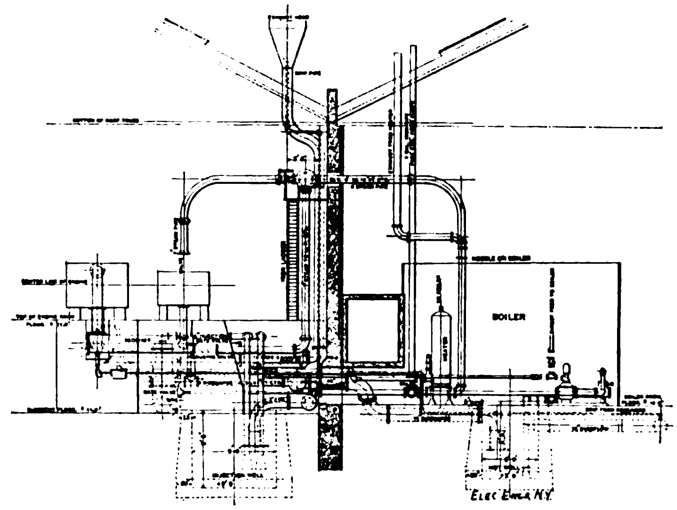
The boiler room is 46 x 150 feet and will contain four batteries of two 250 H. P. Babcock & Wilcox boilers each, making 500 H. P. per battery, guaranteed to carry 150 lbs. pressure. A brick flue extends along the entire length of the back of the boilers discharging into a brick stack 12 feet square at the base with a total height of about 150 feet. The pump space between the second and third boilers contains three Barr pumps any one of which is capable of supplying three batteries of boilers. These are so connected as to take water from the hot well and pass it to the heaters, or from the receiving well in the engine room directly into the boilers. The system of heaters is very complete, one being provided for each engine inside the engine room immediately under the floor and near the condensers, besides two 1000 H. P. Berryman heaters in the pump space in the boiler room. It is intended that the feed pumps shall take the water from the hot well, pass it through the heaters at the engines and then through the Berryman heaters into the boilers at a temperature of about 200 degrees. A simple but substantial system of pipes is used for this purpose and to make the other combinations referred to. A Locke damper regulator, supplied by J. F. Paterson, of Baltimore, with an indicator in the boiler room, is placed in the engine room and automatically regulates the chimney draft.

Coal is unloaded from barges on the river by an elevator and conveyor installed by the Link-Belt Engineering Co., and deposited in bins of 1000 tons capacity at the east side of the building parallel with the boiler room, from which chutes lead to the furnace doors. A narrow gauge track runs the entire length of the boiler house to the wharf, on which is operated an iron car to remove ashes. At the end of this track in the boiler room is placed a set of Fairbanks platform scales to weigh coal during tests.

IV.

We now come to the electric equipment of the station. The generators were built by the General Electric Co., and are said to surpass in uniformity and smoothness of running anything hitherto brought out by them. They are multipolar machines of 400 KW., and, as before mentioned, are directly coupled to the engine shafts running at 100 revolutions per minute.

The arrangement of the switchboard is shown in the engraving on this page. The board is a beautiful piece of work and is built of Italian marble panels set in a handsomely decorated oak frame. It stands at the western side of the engine and dynamo room. The left hand panel contains three sets of instruments for the two generators in use and the one that is now being set up, and a space is left for the fourth generator when the extension of the lines makes the additional power necessary. On the centre panel is a Thomson recording wattmeter and total amperemeter, measuring the total output of the station, and at the right hand are ten feeders with a cut out switch, circuit breaker and ammeter in each. The line is thus divided into ten sections and a blank panel is reserved for additions. Two voltmeters on the extreme left hand panel are placed on a swinging bracket and may either

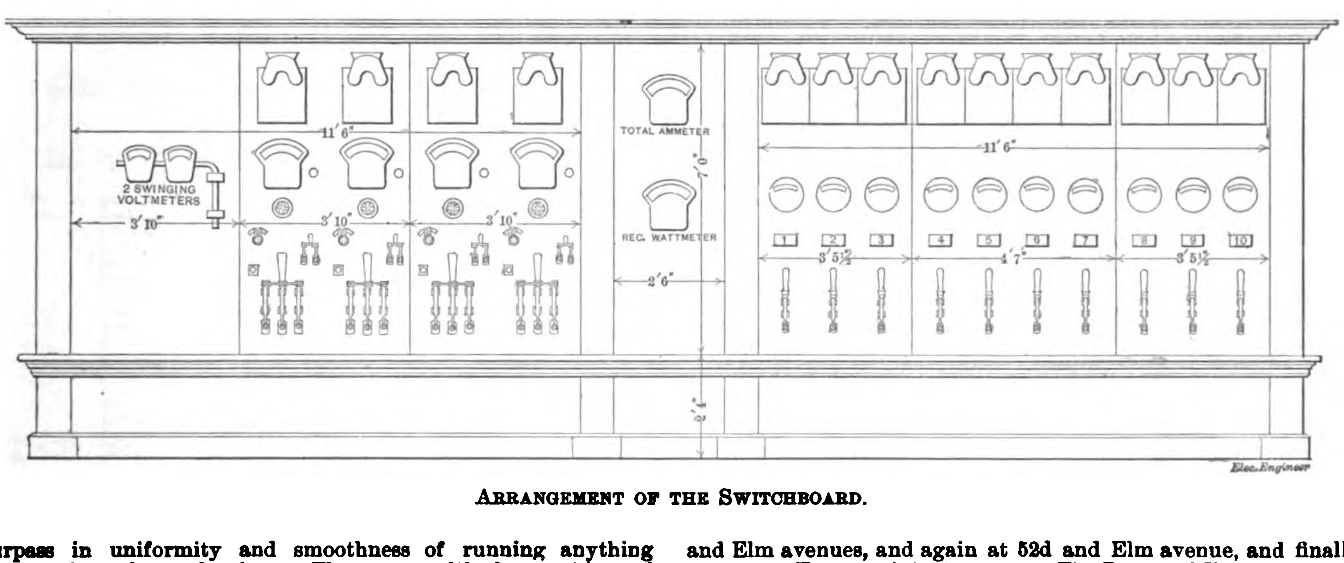


Arrangement of Piping Between Boilers and Engines.

stand at right angles to the board in plain view from the other end or be swung back out of the way when not in use. In the basement is a testing room where instruments for testing the circuits will be placed on a solid brick base resting upon the bed rock. The circuits all pass through this room from the switchboard to the line.

V.

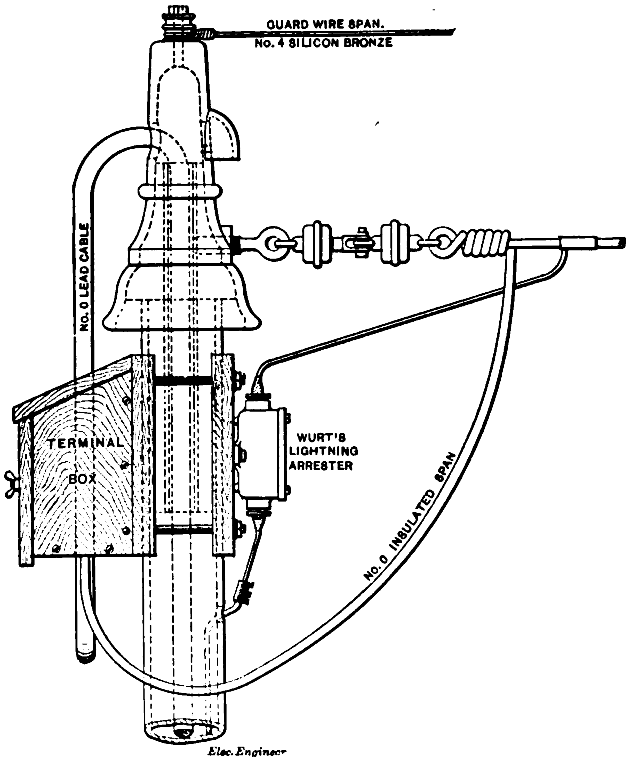
The entire system of the Hestonville, Mantua & Fairmount Passenger Railroad Co. is shown in the map on page 37. The road at present in operation is represented in full lines and the projected extensions are dotted. Commencing at the foot of Arch street, at the Delaware River, the line extends westwardly on Arch to 21st, on 21st to Callowhill, on Callowhill street to 23rd, on 23rd to Spring Garden, on Spring Garden to the Spring Garden street bridge. Crossing the Schuylkill River at this point the line runs out Spring Garden street to Lancaster avenue, out Lancaster avenue to Belmont avenue, striking Fairmount Park at Belmont and Elm avenues, and again at 52d and Elm avenue, and finally returns to Front and Arch streets. The Race and Vine street system starts at the Schuylkill River and runs down Race to 2nd, along 2nd to Dock and Walnut, thence out 3rd to Vine and out Vine to starting point on the Schuylkill. The whole extent of track that will be in operation is about twenty miles, with a gauge of 5 feet, 2½ inches. It is contemplated in the near future to make extension to Overbrook at the City Line. It will thus be seen that the line passes clear from one end of the city to the



Arrangement of the Switchboard.

other, and in the direction in which the city is now growing most rapidly.

The track is laid with 90 pound girder rail, spiked directly to 5 in. by 9 in. by 7 ft. yellow pine ties, spaced 18 inches from



FEEDER-POLE TOP.

centre to centre, or thirteen to the rail. All the special work was made by the Johnson Co. of Johnstown, Pa., and has full 9 inch guard rails, all the curves being of the style recently brought out by that company. This railroal is one of the first to use this section of rail, which was adopted by the Johnson Co. after a conference at their works in the Fall of '93 with a number of street railway engineers from all parts of the country, and has been adopted as a standard. A switch of a uniform radius is being used everywhere.

In constructing all new track the city requires the whole street to be repaved and kept in repair. The track was laid under contract with Chas. A. Porter & Co., of Philadelphia. The rail is bonded with the Johnston rail bond,[1] an invention of the chief engineer of the road, No. 0000 copper wire being used. One of the principal features of this bond is that the contact on bright surfaces is of sufficient area to give the full carrying capacity of the connecting wire. The tracks are also cross bonded every third rail with No. 0 tinned wire and are connected to a stranded ground return cable at the manholes, which are 300 feet apart.

VI.

Ornamental wrought iron side poles are used in most cases. They are built up of six, five and four-inch sections set in six feet of concrete, and each is capped with a hood containing an insulated wooden plug. Thus three points of insulation are interposed between the trolley wire and the earth—the hanger, the span wire insulator and the insulated pole-top. Where the underground system is used, one pole opposite the man-hole is used as a ventilator and the other for the feed wire. At the west end of Lancaster avenue centre poles of exceptionally ornamental design and great strength have been used. Both styles of pole were especially designed by Mr. Johnston and were made by Morris, Tasker & Co.

The span wire is $\frac{5}{16}$ inch seven stranded galvanized steel cable, furnished by Jno. A. Roebling & Sons, attached to span insulators fastened to eye-bolts through the top of the hoods at the side poles. No. 0 hard drawn trolley wire is used, tested to a tensile strength of 4,400 pounds. Pepper & Regester of Philadelphia were contractors for all overhead work At the crossings which are very numerous, the Nelson insulated crossings are used, and where the line crosses the principal bridges, the Johnston automatic safety disconnector[2] is employed to automatically cut out the feeders in case of a break.

As the street railway ordinance of Philadelphia require all feed wires to be placed underground, the Lynch-Lake terra cotta conduit was adopted embedded in cement concrete. The Standard Underground Cable Co. lead encased taped cables were used, guaranteed to give an insulating resistance of 150 megohms per mile, and varying in size from 300,000 to 700,000 circular mils in area. The manholes are located in most cases at all street crossings, and are elliptical in shape. Taps are made from the cables at the manholes, and pass up through the poles to the feed boxes on the side of poles and thence out to the trolley wire. The feeder boxes are bolted on one side of the poles, at the top, with Wurts lightning arresters on the other side.

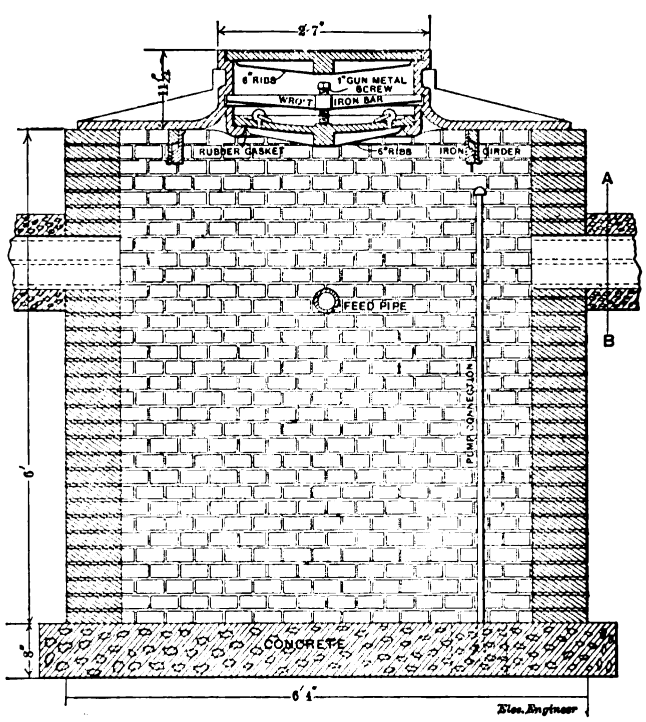
The poles on the bridge are set in iron castings fastened to the columns with expansion bolts. Thirteen of these poles are guyed with 2½ inch gas pipe through which the feeder and light wires pass from conduits beneath the bridge floor. The other bridge poles are guyed with $\frac{5}{16}$ inch steel stranded Roebling cable. The feeder pole top and the man-hole are shown on this page so clearly as to render a detailed description unnecessary. Old rails have been used for the manhole beams and are found both effective and economical. No sewer connection has been provided, as it was feared that such an arrangement would act in exactly the wrong way when the river "backs up" at unusually high water. Instead of this, pipes lead from the bottom of the manholes to the edge of the sidewalks where a small portable pump is simply screwed on when necessary, and any water that has collected is pumped out into the gutter.

VII.

The cars were built by the St. Louis Car Co., and are mounted on Bemis and Peckham trucks. For completeness of design and neatness of construction they are hard to surpass. They have each eleven incandescent lights arranged on two circuits, and electric push buttons between the windows on a dry battery circuit, by means of which passengers can attract the conductor's attention when wishing to stop. Each car is equipped with two General Electric 25 H. P. motors. When fully equipped the road will have about seventy cars.

The old shops and car barns at 43d street and Lancaster avenue have been remodelled and fitted with the necessary new apparatus and machinery, and the stables are now used for storing cars which are run in from the main car shed by means of a transfer table travelling on a track between the two buildings where there is not room for a car to turn.

Every detail of the road displays the utmost care and the exercise of rare engineering skill combined with good taste. The line construction is ship-shape and was built to last, and, since the road was started on November 29, no trouble has been experienced, even during the recent severe storm that wrought considerable havoc on some of the older Philadelphia railways. The engines had been in operation but a few hours when the load



SECTION OF MANHOLE.

was put upon them, and their performance has far exceeded anything that could have been expected. They will soon enter into the contract test and the builders are confident that they will exceed the guarantee called for. They were erected under the direction of H. E. Fisk, Supt. for the Providence Steam Engine Co.

1 See THE ELECTRICAL ENGINEER, May 30, 1894.
2. See THE ELECTRICAL ENGINEER, Jan. 13, 1892.

A. Langstaff Johnston.

VIII.

The officers of the Hestonville, Mantua and Fairmount Passenger Railroad Co. are Johns Hopkins, president; Isaac Blum, vice-president and general manager and W. R. Benson, secretary and treasurer. Messrs. Blum and Benson have taken very active parts in bringing the road to a successful completion and have been seconded by the directors, Simon J. Martin, Ferdinand Marks and Joshua Jones. All the general plans and details of the work have been carried out under the directions of A. Langstaff Johnston, chief engineer, late of Richmond, Va., ably seconded by Mr. D. A. Hegarty, assistant chief engineer and assistant engineers H. A. Clarke, H. W. Armstrong and P. A. Mitchell, and J. D. Lynch, superintendent of the power house.

In this connection a few words in regard to Mr. Johnston's past history will be interesting. He was born in 1850 at Richmond, Va., and was educated at the Virginia Military Institute. Among his instructors were such men as Capt. J. M. Brooke, who made the first survey for the Atlantic cable, and the late Matthew F. Maury, whose scientific writings are so well known both at home and abroad. Mr. Johnston's first railroad work was on the Chesapeake & Ohio, where he undertook the construction of some important tunnels. As assistant city engineer of Richmond, he had charge of a part of the present water works system of that city, after which he was identified with several railway projects in Virginia. The plans of the first electric railway in Richmond were drawn up by him and the success of this work brought him at once into the front rank of electric railway engineers. He has further won distinction by his practical inventions, the most useful of which, perhaps, are the disconnector and the rail-bond mentioned in this article.

Mr. Johnston is a member of the American Institute of Electrical Engineers, the American Society of Civil Engineers and the the Franklin Institute. Previous to his connection with the work upon which he is now engaged he built the New Orleans and Carrollton Railway, the first electric road in the Crescent city, and one which has an enviable record for economy of operation and efficiency of service. Mr. Johnston took charge of the engineering work of the Hestonville, Mantua & Fairmount Passenger Railroad in July, 1893. In the following May, construction work was commenced and the road was opened for traffic the next November, as already stated.

BROOKLYN TROLLEY INVESTIGATION.

The many trolley accidents in Brooklyn have led Mayor Schieren to appoint a special advisory committee to investigate the causes and if possible to formulate plans for the prevention of such accidents. The committee consists of Messrs. John Gibb, W. H. Nichols, John H. Schumann, R. S. Walker and Prof. Austen of the Polytechnic Institute. The State Railroad Commissioners will also take part in the investigation.

A LONG CALIFORNIA ROAD.

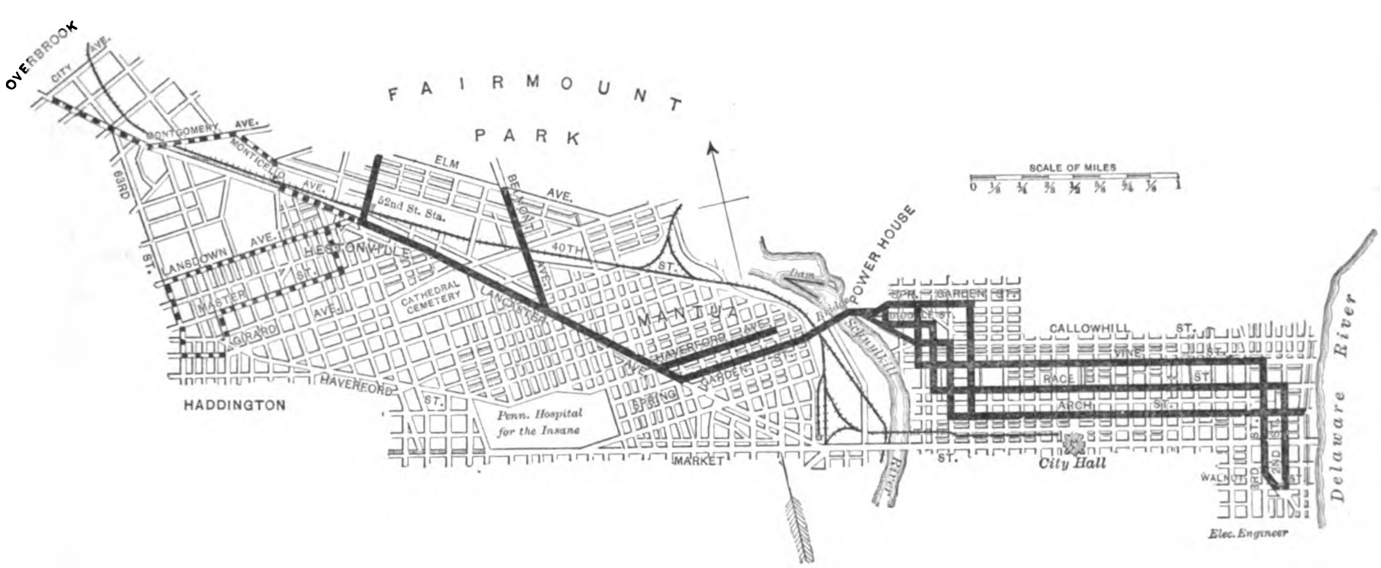
The right of way for an electric railway from Merced to the Yosemite valley has been secured. The capital stock will be $2,500,000. The power plants are to be established at three points on the Merced River. The road will be broad gauge, and will serve the region for freight and passengers, the same as by any ordinary steam railroad. Merced is not quite 140 miles southeast of San Francisco, on the Visalia division of the Central Pacific road. It is the point of departure by stage for tourists visiting the Yosemite valley and falls and the mammoth trees. The length of the proposed electric road will be about sixty-five miles. It will greatly increase the number of tourists.

A STANDARD GAUGE ROAD FOR MICHIGAN.

Travers City expects to have the honor of being the birthplace of the first standard gauge electric railroad in Michigan. Articles of incorporation have been filed for the Traverse City, Peninsula & Old Mission electric railroad company. The capital stock is $160,000 and the incorporators are Judge J. J. Ramsdell and ten other prominent men from Traverse Bay region. The road will run 20 miles north from Traverse City along the lake shore, striking an extensive fruit belt and many summer resorts, and will not only be of standard gauge, but will run passenger coaches of standard railroad size.

BALTIMORE CITY RAILWAYS.

The report that the Baltimore City Passenger Railway Company and the Baltimore Traction Company, each of which operates several lines of cable and trolley street cars, are to be consolidated, is disputed. Gov. Frank Brown, President of the latter company, denies that there is any such scheme on foot, although his company is apparently willing to make the change. Gov. Brown thinks that it would be a good plan to consolidate all the street-car lines in the city, but does not consider that such an arrangement can be brought about. "It ought to be done, and will be done eventually, I am sure," said the Governor, "not only in the interest of the companies, but also in the interest of the public. But the present owners of the City Passenger Company are opposed to it, and, consequently, nothing will be done while they remain in their present state of mind, unless, indeed, their stock should pass into other hands, which will probably not happen." The stockholders of the City Passenger Company are receiving dividends of from 8 to 10 per cent. on their investment, and none of the stock can be bought.



MAP SHOWING THE HESTONVILLE, MANTUA & FAIRMOUNT PASSENGER RAILROAD CO.'S LINES, PHILADELPHIA.

LEGAL NOTES.

STAR AND SUNBEAM LAMP COS.

With regard to the recent action of Judge Seamans in Chicago dissolving the injunction against the Star and Sunbeam Incandescent Lamp Cos. pending the Bate decision, it appears that the order has not been filed, as those companies do not care to put up the bond exacted as a condition of the suspension. They are hopeful as to the Bate case, but it has seemed to them prudent and best not to go ahead, as it would be highly disadvantageous to arrange to operate their factory at its full capacity, only perhaps to shut down again after a few weeks, should the Bate suit go in favor of the Edison interests. If the Bate decision were postponed indefinitely that would change matters, but a long delay is not expected by anybody.

WESTERN UNION SHARE OF TELEPHONE STOCK—FURTHER DECISION IN BOSTON.

The United States Circuit Court of Appeals in Boston, on Jan. 2, in the writ of error brought by the American Bell Telephone Company against the Western Union Telegraph Company et al., ordered the decree of the United States Circuit Court reversed, and the case remanded to that court for further proceedings. This originally was a suit in equity brought by the Western Union Telegraph Company, the American Speaking Telephone Company, the Gold and Stock Telegraph Company, and the Harmonic Telephone Company against the American Bell Telephone Company, as the successor of the National Bell Telephone Company. These companies asked for an accounting and transfer to them of one-fifth part of a large number of shares in capital stock of sundry corporations operating telephone exchanges throughout the United States, and the dividends thereon, and one fifth of certain sums paid the American Bell Telephone Company for licenses to connect telephone exchanges with each other, and one-fifth of any and all bonds or other securities or property received for licenses under a contract dated Nov. 10, 1879, which was to continue for seventeen years from that date.

After the filing of the bill, answer and replication in the Circuit Court, the parties consented to the reference of the case to John Lowell, as Master, to find the facts and report such parts of the evidence as either side desired. The Master concluded that the complainants (the Western Union Telegraph Company et al.) were not entitled to the accounting from the defendant which they asked for, and his report was filed. This report was subsequently withdrawn for further proceedings before the Master, and before it was finally filed in court, the complainants moved for leave to dismiss their bill, without prejudice, on payment of costs. This the Circuit Court permitted them to do, and a decree was entered accordingly. From this particular decree the defendant took an appeal, by a writ of error, to the Court of Appeals. This appeal was argued several months ago before Justices Putnam, Nelson, and Webb. The appeal is now successful, and the opinion of the Court of Appeals, which will be soon filed, will direct what shall be done with the case in the Circuit Court.

SOCIETY AND CLUB NOTES.

MEETING OF THE UNDERWRITERS NATIONAL ELECTRIC ASSOCIATION.

A meeting of the Underwriters International Electric Ass'n and of the Electrical Committee of the Ass'n was held in New York on Wednesday and Thursday, Dec. 19th and 20th, to take into consideration such matters as might properly come before them in regard to the electrical hazard. The name of the Association was changed to the Underwriters National Electric Ass'n, and the Articles of Association were amended somewhat to the end that the Association, as an Association outside of the Electrical Committee, might do more effective work.

The following officers were present:—C. E. Bliven, Pres't; C. M. Goddard, Sec'y; F. E. Cabot, Chas. Wm. McDevitt, A. K. Van Geisen, E. A. Fitzgerald, W. H. Merrill, Jr., A. M. Schoen, A. E. Braddell of the Electrical Committee.

The rules were very thoroughly gone over, and a very few amendments which seemed necessary were made. Steps were taken toward securing even a greater uniformity of rules throughout the country than had as yet been secured by the Association, although the rules recommended by the Association are now in force in nearly the whole territory. The matter of securing uniform rules for Automatic Fire Alarm system was considered, and referred to a special Committe of three for a full report.

The following resolution was adopted to the end that the question of how far electric railroads were affecting underground pipes by electrolysis might be thoroughly looked into, and such recommendations as were needed adopted:—

"*Resolved*:—That each Inspector be requested to make tests for difference of potential due to trolley roads between water and gas mains and other underground metallic conductors, and between them and the earth itself, in the various towns and cities in his territory, and report to the Secretary of the Association at as early a date as possible."

The question of transformers was considered, and also the question of limiting the potential of the primary wires for transformers whose secondaries enter insured risks, and the matter was referred to a special sub-committee for a report.

The matter of protection of overhead wires normally carrying a harmless current, but liable to come in contact with high potential wires, and thus carry a current into insured risks on wires not installed with regard to the carrying of high potential currents, was discussed and action taken looking toward the obviating of this hazard.

The matter of a standard for fuse metal was also considered and referred to a sub-committee.

Much other business of considerable importance was transacted both by the Association and Committee, which will be included in the full reports of the meetings, which will be sent to the various Underwriters Organizations throughout the country.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Mr. T. Ahearn, Managing Director of the Ottawa Electric Railway and a member of the American Institute of Electrical Engineers in behalf of the Carnival Management has extended a hearty invitation to his fellow members and their friends to visit Ottawa, Ont. during the week of the Grand Winter Carnival, January 21st to 26th. The many attractive features of the Canadian capital city, are well known to travelers and Ottawa is generally recognized as one of the electrical centres of the Dominion.

N. E. L. A. TRANSPORTATION RATES.

Mr. C. O. Baker, Jr., the Master of Transportation for so many years past of the National Electric Light Association, has already begun his work for the Cleveland meeting, and we have receieved the following notification from him: "The Central Traffic Association have granted application for excursion rates to the Cleveland meeting, and it gives me pleasure to announce that the rate from all points in their territory to Cleveland will be a fare and one-third for the round trip, on the certificate plan. The other associations will undoubtedly concede the same rate, due notice of which will be given."

NORTHWESTERN ELECTRICAL ASSOCIATION.—The third annual meeting of the association will be held at Milwaukee on January 16th and 17th next. The Club Rooms of the Pfister Hotel have been secured and it is expected that the meeting will be even better attended and prove more interesting than the last semi-annual meeting at St. Paul. An elaborate program is in preparation and the papers to be read are all of practical value to central station men. Among the papers already definitely assured are the following: John R. Markle, Chicago, "Some Characteristics and Economics of Accumulators as applied to Central Lighting and Power Stations." J. S. Stephens, Chicago, "Boilers." Pliny Norcross, Janesville, Wis., "Hints upon Daily Work about a Dynamo Plant." William Goltz, Milwaukee, "Incandescent Lamps vs. Welsbach Burners." Geo. Grimm, Jefferson, Wis., "Wants of Station Managers." Chas. E. Burton, Chicago, "Interior Conduit and Interior Wiring."

There will be all necessary facilities for exhibitors to show their goods. The Chicago & Northwestern Ry. will carry delegates and their friends from any point on their lines for a fare and one third, on the certificate plan. A limited special will leave the Wells St. Depot, Chicago, at 8.30 A. M. January 16th, arriving in Milwaukee at 10.50 A. M. Further particulars can be obtained from the secretary of the association, H. C. Thom, Madison, Wis.

MARRIED.

O'HARA—HICKEY.

On December 27 John B. O'Hara, the managing editor of the *Western Electrician*, was married at Rochester, N. Y., to Miss Margaret Hickey, daughter of the late Jeremiah Hickey, who was for many years a prominent resident of that city. The marriage service was conducted by the Rev. Felix O'Hanlon in the Convent of Mercy, and Mr. and Mrs. O'Hara then started on a long wedding trip in the East and South. Mr. O'Hara's associates are joined in their congratulations by a great many others in the electrical field who have learned to appreciate his many sterling qualities.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JAN. 1, 1895.

Alarms and Signals:—

Electric Block Signal, C. H. Sallada, Pittsburg Pa., 531,651. Filed Apl. 9, 1894.
A system by which an alarm is given in the locomotive cab.
Electric Signal, W. J. Wessenberg and H. P. Wilbur, Meriden, Conn., 531,708. Filed Aug. 12, 1893.
A visual signal operated by a swinging magnet armature.
Electromagnet, W. J. Wessenberg and H. F. Wilbur, Meriden, Conn., 531,709. Filed Sept. 27, 1894.
A detail of the above.
Electric Railway Signal, J. Frank, New York, 531,919. Filed Nov. 27, 1893.
Railway Signal, D. H. Wilson, Chicago, Ill., 531,986. Filed Feb. 10, 1894.
Combination of a railway signal with an electric fence for the purpose of keeping animals off the track.
Electric Signaling Apparatus, G. E. Miller, Saugus, Mass., 532,003. Filed Jan. 24, 1894.
A signaling system between trains on the same track.
Electric Semaphore Setting Device, H. A. Parrish, Jackson, Mich., 532,009. Filed Feb. 10, 1894.

Conductors, Conduits and Insulators:—

Electric Wire Holder or Insulator, A. Iske, Lancaster, Pa., 531,635. Filed May 29, 1894.
An insulator comprising two portions, one having a central socket and the other having a central plug fitted into the socket.
Cleat for Electric Wiring, J. H. Swift & W. F. Maintien, Plainville, Mass., 531,702. Filed Mch. 17, 1894.
A two part cleat especially adapted for interior wiring.
Safety Device for Electric Circuits, T. Harden, London, Eng., 531,929. Filed Apl. 27, 1894.
A grounding safety device combining a sparking point, a fusible wire and a catch mechanically held by the wire which allows of the earthing of the wire when the catch is released.

Distribution:—

Transmuter for Electrical Currents, W. J. Still, Toronto, Can., 531,657. Filed Apl. 5, 1893.
A device by which alternating current is transformed into continuous current, consisting of a revolving commutator driven by electric motor.
Electric Car Lighting Apparatus, W. Biddle, Brooklyn, N. Y., 531,764. Filed May 8, 1894.
A polarized compound switch employed to maintain uniform direction of current in the field magnet and to break the circuit when the speed of the car falls below a certain limit.
Circuit Regulating Device in Electric Car-Lighting Apparatus, W. Biddle, Brooklyn, N. Y., 531,765. Filed May 28,1894.
A device for maintaining constant current at variable speeds in connection with storage batteries for car lighting. Employs a neutralising or differential coil in shunt to the armature brushes.
Circuit Controller, T. Parker, J. H. Woodward & E. S. G. Rees, Wolverhampton, Eng., 531,961. Filed Feb. 24, 1892.
Detail of No. 531,962.
Distribution of Electricity, T. Parker, J. H. Woodward & E. S. G. Rees, Wolverhampton, Eng., 531,962. Filed Feb. 24, 1892.
A system by which either low tension current can be supplied direct to the distributing main or the transformers may be thrown into circuit to convert the high tension current from the supply into low tension for the distributing mains.
Electric Converter, R. H. Hassler, Pittsburg, Pa., 531,996. Filed April 30, 1894.
The ends of the coil projecting from the core are spread apart for better ventilation.

Dynamos and Motors:—

Armature for Dynamo Electric Machines or Motors, W. Decker, Owego, N. Y., 531,628. Filed Nov. 17, 1892.
Two series of coils each having a rectangular form but having sides of different lengths, the shorter of the series of coils being arranged on the core with their longer sides adjacent to one another at distances less than the width of any side of any coil.
Brush for Dynamo Electric Machines, J. B. Wallace, Ansonia, Conn., 531,707. Filed April 30, 1894.
A brush made of gauze with a surrounding wrapper of gauze or cloth of a high resistance material.
Method of Operating or Controlling Electric Motors or Dynamos, E. Eickemeyer, Yonkers, N. Y., 531,790. Filed Nov. 2, 1891.
Effects a regulation by changing mechanically the path in which the magnetism flows in the magnetic circuit of the machine without changing the electric circuits, and at the same time without any change in the strength of the magnetic flux.
Constant Current Dynamo, J. J. Wood, Fort Wayne, Ind., 531,821. Filed July 3, 1894.
Covers details of construction of the new Wood arc machine described in THE ELECTRICAL ENGINEER June 20, 1894.

Lamps and Appurtenances:—

Base for Incandescent Electric Lamps, G. C. Thomas, South Framingham, Mass., 531,663. Filed Nov. 28, 1893.
Uses a vitreous infusible substance for the insulating parts.
Electric Arc Lamp, C. A. Pfluger, Chicago, Ill., 531,698. Filed Apl. 5, 1894.
Claim 2:
The combination in an arc lamp of a shunt and series coil, a pivoted lever controlled by the series coil, a second pivoted lever controlled by the shunt coil and an elastic connection between the two levers, a clutch associated with one of the carbons of the lamp and connected with the lever controlled by the shunt coils whereby said clutch is used only by the movement of the shunt coil lever.
Electric Arc Lamp, A. Schweitzer, Allegheny, Pa., 531,751. Filed June 22, 1894.
An arc lamp having circular carbons with appropriate regulating mechanism.
Cut-Out Box, G. H. Alton, Lynn, Mass., 531,761. Filed Feb. 7, 1890.
A cut-out box with a fuse carried on a hinged lid.
Adjusting Mechanism for Arc Light Carbons, E. F. G. H. Faure, Schenectady, N. Y., 531,840. Filed Aug. 22, 1894.
Intended for search lights to effect the alignment of the carbons so that the arc is produced at the point best adapted for the reflection of light.
Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 531,978. Filed May 7, 1891.

Measurement:—

Method of and Means for Measuring Energy of Alternating Electric Currents, O. B. Shallenberger, Rochester, Pa., 531,866. Filed Sept. 19, 1894.
For description see THE ELECTRICAL ENGINEER Jan. 2, 1895.
Method of and Means for Measuring Alternating Electric Currents, O. B. Shallenberger, Rochester, Pa., 531,867. Filed Sept. 19, 1894.
For description see THE ELECTRICAL ENGINEER Jan. 2, 1895.
Indicating Watt Meter for Alternating Electric Currents, O. B. Shallenberger, Rochester, Pa., 531,869. Filed Sept 19, 1894.
For description see THE ELECTRICAL ENGINEER Jan. 2, 1895.
Watt Meter for Multiphase Alternating Electric Currents, O. B. Shallenberger, Rochester, Pa., 521,689. Filed Sept. 19. 1894.
For description see THE ELECTRICAL ENGINEER Jan. 2, 1895.
Alternating Current Measuring Instrument, O. B. Shallenberger, Rochester, Pa., 531,870. Filed Nov. 24, 1894.
For description see THE ELECTRICAL ENGINEER Jan. 2, 1895.
Electrostatic Voltmeter, H. A. Rowland, Baltimore, Md., 531,970. Filed Feb. 24, 1894.
An electrostatic voltmeter having its attracting and attractive parts immersed in a non-conducting liquid.

Miscellaneous:—

Electric Steam Engine Governor, C. B. Melott, Rondout, N. Y., 531,849 Filed July 21, 1894.
The movement of the governor balls are assisted by magnet coils acting upon iron cores.

Railways and Appliances:—

Closed Conduit for Electric Railways, R. J. Turnbull, St. Paul, Minn., 531,664. Filed Jan. 19, 1894.
A conduit formed in two longitudinal parts with conductor rails formed in sections and held between the parts of the conduit and projecting downward; the top of the conductor extends above the upper surface of the conduit. Connection is made with the conductor by a traveling magnetic device.
Trolley, T. Cooper, Providence, R. I., 531,837. Filed Sept. 17, 1894.
The trolley is provided with side plates in fixed rotation with the contacting wheel.
Electric Railway, A. A. Shobe & W. Embley, Jerseyville, Ill., 531,873. Filed July 24, 1894.
A system in which current is taken from a series of separately insulated bars laid along the track brought into contact as the car passes over them.
Electric Rail Bond, G. E. Somers, Bridgeport, Conn., 531,960. Filed May 7, 1894.
Stranded conductors with the ends secured by ferrules.

Telegraph:—

Printing Telegraph, S. V. Essick, Yonkers, N. Y., 531,677. Filed Apl. 20, 1892.
An improvement on the same inventor's page-printing telegraph.
Telegraphic Transmitter, J. J. O'Neill, New York, 531,854. Filed Feb. 28, 1894.
An improved keyboard transmitter.

Telephones:—

Telephone Indicating Apparatus, J. L Sabin & W. Hampton, San Francisco, Cal., 531,650. Filed July 25, 1894.
Consists of an auxiliary non-restoring indicator actuated when the subscriber removes his telephone from the hook or hangs it up, which is used as an auxiliary to the visual self-restoring indicator to indicate that the subscriber desires disconnection.
Telephone Switch, A. G. Davis, Baltimore, Md., 531,913. Filed Nov. 23, 1893.
The object is to provide for switching the telephone instrument into the main circuit or to switch the call into the main circuit, the receiving instrument and the call switch being normally out of the main circuit.

OBITUARY.

COL. S. PALMER.

The death is announced of Col. S. Palmer at St. Louis, Mo., aged 72. Col. Palmer was one of the pioneers in telegraph construction. He went into the business when Ezra Cornell and Col. Speed put up the first money which made telegraphing a business, and built the first line out of New York in 1845. He was connected with the Western Union company about forty years, building most of its lines in the West. He put the lines along every railroad that went into St. Louis. During the war he constructed lines for the government. He had been active in the business up to the beginning of his illness four or five months ago.

F. P. LITTLE.

It is with deep regret and sorrow that just as we go to press we receive the news of the death of Mr. F. P. Little, of Buffalo. He was well known to the electrical fraternity, having for years past been actively engaged in electric lighting work and in the installation of electric light and power plants all over New York State. More recently he had engaged in electrical manufacture. Some months ago he had the misfortune to be thrown from his buggy, sustaining severe injuries. Last December he underwent an operation from the effects of which he never rallied. Such able and generous men can ill be spared from the industrial ranks of electricity.

W. WILEY SMITH.

IT is with deep regret that we record the death of W. Wiley Smith, the well known secretary of the Missouri & Kansas Telephone Co., at Kansas City on Dec. 29. Mr. Smith was a veteran telephonist and telegrapher, and was of a fertile and inventive mind, making his mark on many improvements in the art. The funeral took place on Dec. 31 and was largely attended.

LONG ISLAND CITY, L. I.—A contract was recently awarded to the new Long Island City Electric Illuminating & Power Co. for 813 city lights, but the work of getting them up has been slow. Power is furnished from the Steinway Railroad Co.'s power house at Astoria.

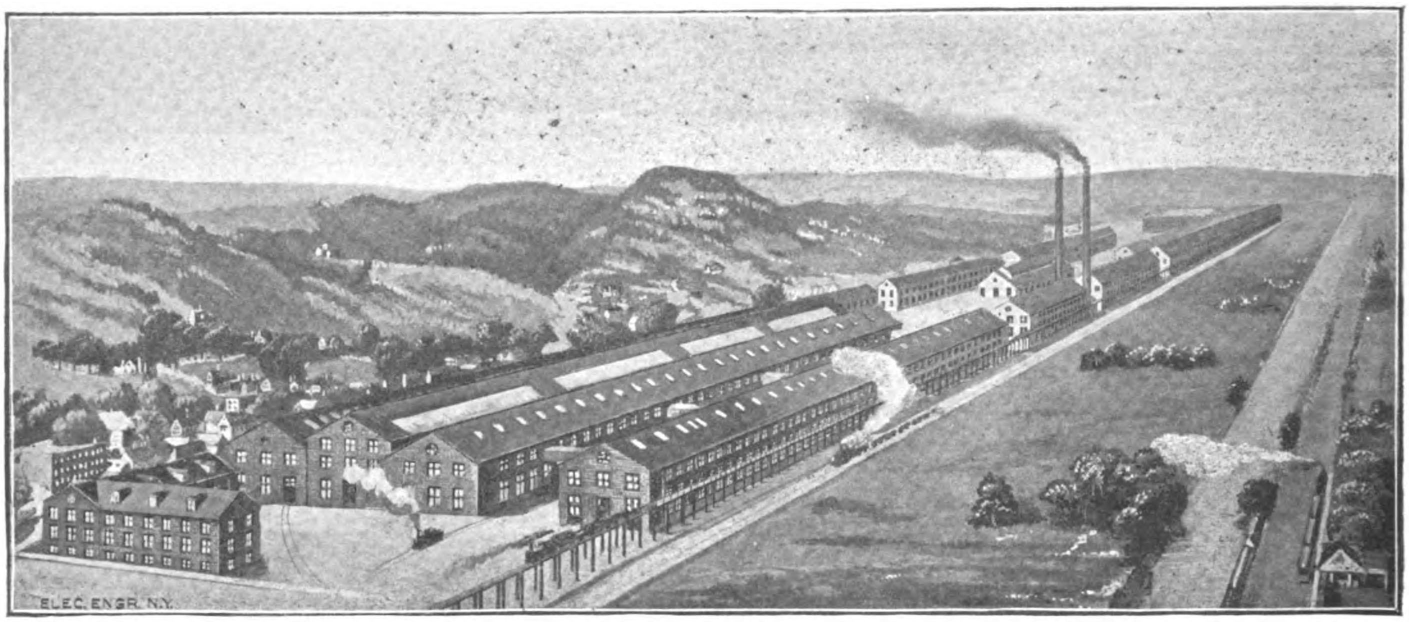
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NEW WESTINGHOUSE WORKS AT BRINTON, PA.

The Westinghouse Company has just issued a beautifully printed souvenir, illustrating its new works, now nearing completion, the main buildings of which were used for the reception by the citizens of Pittsburg in honor of the visiting officers and delegates to the 28th National Encampment of the Grand Army of the Republic, on the evening of September 12, 1894, at which time there were present 6,500 guests on invitation of the committee having in charge the entertainment of the Grand Army.

The buildings are located upon a block of land of 40 acres, having a frontage of 2,300 feet along the main line of the Pennsylvania Railroad, at Brinton, Pa., 12 miles from Pittsburg, and it is proposed to concentrate here all the manufacturing of the company, which now employs 3,500 operatives. The new shops are extensive and will be unexcelled in completeness of detail. They have been laid out and constructed with reference to economy and convenience in the manufacturing of electrical apparatus, and they have been so designed as to admit of future extensions to accommodate the constant growth of the company's business.



THE NEW WESTINGHOUSE WORKS AT BRINTON, PA.

The railroad facilities to and on the grounds of the company are ample and convenient. Electric cranes traverse the buildings, and from building to building, and are capable of handling the largest machinery.

The five buildings now completed are the machine shop and the warehouse (the two large buildings side by side in the foreground of the picture); the power house, lying beyond the warehouse; the sheet iron department, immediately beyond the two chimneys; and the blacksmith shop, which is at the side of the sheet iron department. The addition of the foundry, carpenter shop, and one or two minor buildings will complete the plant as far as intended at present.

These works are being constructed under a contract with the East Pittsburg Improvement Company as the principal contractor. The contracts were let in February, so that but a little over six months have been consumed in the completion of the machine shop and the warehouse.

The dimensions of the buildings are as follows: machine shop, 231 feet by 754 feet; warehouse, 76 feet by 754 feet; power house, 76 feet by 205; sheet iron department, 76 feet by 258 feet; blacksmith shop, 83 feet by 243 feet.

The area of the first floor of the machine shop is 4 acres, and of both floors 7 acres. The area of the floors of the five buildings is 10.8 acres. The following materials were used; cubic yards of stone masonry, 16,037; number of brick, 4,638,000; feet board measure of lumber, 6,000,000; weight of steel, pounds, 9,000,000.

"A BAG OF DATES" is the clever little calendar issued by the John A. Roebling's Sons Co., accompanied by some really charming sentiments for the New Year, as well as for January, 1896.

THE BRILL CAR TRUCK INFRINGEMENT SUITS.

MENTION was made in our last weeks issue of suits brought by the J. G. Brill Company, against two electric roads in Philadelphia for infringement of patents on several features of the Brill trucks. We have since been informed that the only reason for bringing the suits against the Philadelphia roads was for the purpose of having the case tried in the Philadelphia Court. The Brill Company state that they have no desire whatever to hamper the action or operation of any railway company and it was merely their desire to bring the suit at home that led to the suits referred to. It is to be taken for granted that a railroad company purchasing special trucks or appliances relating to cars usually holds the builders or sellers responsible for damages which may be incurred by patent suits and as the Brill Company desire to get at the makers only, they thought they could possibly do so by entering suits against the railway companies who will compel the manufacturers to defend the suits.

FESTIVITIES OF WARREN & LOZIER.

The young but active firm of Warren & Lozier celebrated their remarkable success during the terribly dull year of 1894, by inviting their employees to dine with them on New Year's Eve, at the Maison Française, in Hubert street—one of those quaint restaurants in the down town quarter that blend old New York and old Paris so delightfully. The employees responded with a will to the number of about 40, and Messrs. Warren & Lozier were also joined by some friends including Mr. A. D. Page, of the Edison Lamp Works; "honest Joe" Barr; Mr. C. Ward, formerly of the firm, and Mr. T. C. Martin. A most pleasant and fraternal evening was spent, and several rattling speeches were made, those by the foremen and other employees evincing the good will that has done so much to give the still growing firm its rapid but solid success.

SERRELL'S ELECTRIC RAILWAY DATA.

Mr. L. W. Serrell, M. E., of the Postal Telegraph Building, has issued a most interesting and valuable little brochure on the subject of electric railway work. It brims over with facts, figures and pointers derived not from his inner consciousness, but from his hard-won experience as a designer, builder and consulting engineer of electric roads for some years past. It deals with track and overhead construction, feeders, bonding, bridges, car houses, cars, and all the items of operation. The illustrations are practical, being taken chiefly from photographs of roads now in successful operation.

ELECTRIC PLANT AT SALT LAKE CITY.

THE CITIZENS ELECTRIC LIGHT CO., of Salt Lake City, Utah, has been incorporated by Chas. Boettcher, of Denver, Col. The capital stock is $500,000. The company will commence work at once and is now in the market for engines, boilers, wire, electric plant, etc.

S. F. B. MORSE & CO.

The well known and popular firm of Cushing & Morse, which for years has been the General Western Agent for Kerite wires and cables was dissolved on the first inst., Messrs. S. F. B. Morse & Co. succeeding to the business, Mr. Morse having bought out Mr. Cushing's interest. In leaving the firm Mr. Cushing takes with him the best wishes of the electrical fraternity, and it is hoped that the probability of his remaining in the electrical field may become a certainty. That the new firm under Mr. Morse's able management will at all times maintain its popularity and keep the merits of Kerite before the public in a successful manner, is a foregone conclusion.

PHOSPHOR COPPER AND PHOSPHOR BRONZES.

Phosphor-copper and phosphor-bronzes are being more and more extensively used. The peculiar change which copper and bronzes undergo when fluxed with phosphorus is not well understood, but the effects are fully appreciated, strength and toughness are increased and liability to corrosion decreased. For these reasons phosphor-bronzes are being used very largely in marine and railway construction. The charging of the phosphorus into the molten metal must be done with considerable system and care. This part of the operation may be safely and easily accomplished by the aid of phosphorus chargers or phosphorizers made of plumbago. The Jos. Dixon Crucible Co., Jersey City, N. J., who make plumbago goods in great variety for metallurgical purposes, also make these phosphorizers in different sizes, suited to the size of the crucible in which the fluxing is to take place.

CONTINUED PROSPERITY OF THE MATHER COMPANY.

The Mather Electric Company of Manchester, Conn., report a very bright outlook for the year of 1895. In fact, the company has at no time during its existence had so many orders on its books as it has to-day. The company now have in course of construction in their works at Manchester, the following apparatus on orders: five 200 K. W.; twelve 100 K. W., one 80 K. W., eight 60 K. W., three 45 K. W., three 30 K. W. belted generators of their new multipolar type; also, three 100 K. W., one 80 K. W., two 65 K. W., two 50 K. W. and one 30 K. W. direct connected generators of their new multipolar type; and, also, thirty-one ring type dynamos and seventy Manchester motors of various sizes.

Notwithstanding the extensive additions in the way of new tools and facilities which have been added recently to their Manchester plant, the company have found it necessary for the last two months to operate their entire plant twenty-four hours a day with two shifts of men, but so far have been unable to keep up with their orders. During the three first days of January, the Mather Company closed contracts for ten generators aggregating 1300 kilowatts, for railway and power work.

BIDS FOR FIXTURES IN GOVERNMENT BUILDINGS.

Bids were opened at the Treasury Department, Washington, on Jan. 3, 1895, for manufacturing and placing in position in the United States Government buildings at Cedar Rapids, Iowa, Fort Dodge, Iowa, Lowell, Mass., Sheboygan, Wis., and Sioux Falls, S. D., combination gas and electric light fixtures. The following is a list of the bidders:

San Francisco Novelty & Plating Co., San Francisco, Cal., for Fort Dodge, $841.80; Sheboygan, $687.20; Sioux Falls, $1,791.20; Lowell, $1,231.80; Cedar Rapids, $879.40.

Mitchell Vance Co., New York, N. Y., Fort Dodge, $812.95; Sheboygan, $651; Sioux Falls, $1,367.65; Lowell, $1,262.20; Cedar Rapids, $690.70.

Brooklyn Gas Fixture Co., Brooklyn, N. Y., Fort Dodge, $708.40; Sheboygan, $439.50; Sioux Falls, $1,138.75; Lowell, $710.60; Cedar Rapids, $543.55.

Sheboygan Electric Lighting Co., Sheboygan. Wis., Sheboygan, $754.20.

Page Bros. & Co., Boston, Mass., Lowell, $1,233.10.

Schultz Gas Fixture & Art Metal Co., Baltimore, Md., Fort Dodge, $714; Sheboygan, $488.30; Sioux Falls, $1,138.10; Lowell, $752.75; Cedar Rapids, $619.65.

W. C. Vosburg Mfg. Co., Limited, Brooklyn, N. Y., Fort Dodge, $861.50; Sheboygan, $654.75; Sioux Falls, $1,892.30; Lowell, $1,013.50; Cedar Rapids, $755.25.

R. Hollings & Co., Boston, Mass., Fort Dodge, $798.25; Sheboygan, $552.50; Sioux Falls, $1,297.25; Lowell, $963; Cedar Rapids, $681.

Horn & Brannon, Philadelphia, Pa., Fort Dodge, $603; Sheboygan, $430; Sioux Falls, $908.75; Lowell, $765.50; Cedar Rapids, $469.

Cassidy & Son, Mfg. Co., New York, N. Y., Fort Dodge, $663; Sheboygan, $403.70; Sioux Falls, $1,456.40; Lowell, $758.90; Cedar Rapids, $576.70.

Simon Mfg. Co., Philadelphia, Pa., Fort Dodge, $635.05; Sheboygan, $484.45; Sioux Falls, $1,090.20; Lowell, $824.75; Cedar Rapids, $537.95.

Morrison Southern Electric Co., Baltimore, Md., Fort Dodge, $755; Sheboygan, $389.50; Sioux Falls, $1,032.50; Lowell, $681.50; Cedar Rapids, $725.

NEW YORK NOTES.

MR. LEWIS K. DAVIS, consulting engineer, Manhattan Life Building, has complimented us with a neat memorandum desk calendar, which has various neat pointers about it for recording data and jogging the memory.

CHAS. D. SHAIN has surprised and delighted his hosts of acquaintance by dropping into verse on the occasion of the new year. He has got over the lameness due to his serious accident, and both he and his verse are without any limp. Mr. Shain is driving for a large business this year.

MESSRS. GODFREY, HARRINGTON & OLSEN, who now have the selling interests of Habirshaw wires and cables in hand at Room 52, No. 15 Cortlandt street, received about 300 of their friends there, with light refreshments, between the hours of 2 and 6 on New Year's Eve. The occasion was propitious for the expression of lots of good will and best wishes.

MR. J. A. MACHADO, of 203 Broadway, hasbeen appointed manager in New York for the Triumph Electric Co. of Cincinnati, whose excellent apparatus for light and power has been illustrated in these pages. This arrangement means that the company will be brought into closer and more intimate relations with Eastern trade, and will no doubt lead to a large increase in their business. Mr. Machado will retain the other special agencies, etc., with which his name is now associated.

NOLL & MACLEAN, the contracting electrical engineers, have now opened their offices and store rooms at 8 East Seventeenth street. They are starting out to do only first class and modern work, and intend to restrict themselves to contracting, believing that one field properly attended to, is sufficient to absorb all their energies, while at the same they will thus keep clear of branches to which others are devoting their entire time, such as supervising electrical engineers. The wisdom of this course must certainly commend and approve itself to the electrical community.

MR. JAS. F. KELLY, one of the oldest, ablest and best known men in the field of insulated wire, has joined the selling department of the New York Insulated Wire Co., and starts out the new year briskly. In the service of the Electrical Supply Co., the Edison Machine Works, the General Electric Co., and other concerns, Mr. Kelly has won many friends and a large following; and he has the heartiest good wishes from all. Associated with Mr. Kelly will be Messrs. H. C. Whitney, P. H. Hover, Lewis O. Brewster and Harry Gue, all of whom have a high standing in the electrical trade.

"WATERTOWN ENGINES" is a dainty brochure issued by the Watertown, N. Y., Engine Co. giving some pictures of their excellent engines together with some testimonials from users. There is also some data on Watertown boilers and a list of recent orders. Among purchasers of both engines and boilers we are glad to note many electric light and power companies or plants. The November list of sales of the Watertown engine is a long and juicy one, as follows:—Standard Ladder Co., Glenville, O, 10x14 Excelsior automatic; Rowell & Chase Mach'y Co., Kansas City, Mo., 10x14 Excelsior automatic; Lord & Burnham Co., Irvington, N. Y., 9x12 Excelsior automatic; E. P. Hampson & Co., N. Y., 11x14 Excelsior automatic, with boiler; S. L. Holt & Co., Everett, Mass., 8x12 Excelsior automatic; Lehigh Valley Railroad Company, 7x10 Excelsior automatic; Home Insurance Co., Minneapolis, Minn., 12x14 Excelsior automatic; Williams & Werner, Rochester, N. Y., 12x20 slow speed automatic, with boilers; Hendrie & Bolthoff, Denver, Col., 12x20 slow speed automatic; Keystone Lime and Sand Co., Tyrone, Pa., 12x20 slow speed automatic, with boilers; Stevens & Thompson, N. Hoosick, N. Y., two 12x20 slow speed automatic, with boilers; Chadwick Leather Co., Chadwicks, N. Y., 12x20 slow speed automatic, with boilers; Piercefield P. & M. Co., Piercefield, N. Y., two 16x28 slow speed automatic, six boilers; Missouri Medical College, St. Louis, Mo., 8x10, high speed automatic; Vienna Electric Light Co., Vienna, Ill., 9½x10 high speed automatic and boiler; New York Air Brake Co., Watertown, N. Y., 9x10 high speed automatic; Manuel Escovar, Mexico, 8x10 high speed automatic; Manuel Escovar, Mexico, 12x14 high speed automatic; Nelson Hotel Co., St. Louis, Mo., 12x14 high speed automatic; Merle & Heaney, Chicago, Ill., 12x14 high speed automatic, with boiler; Seville Apartment House, New York, 10x10 direct connected high speed; B. Goldsmith, Milwaukee, Wis., 9½x10 direct connected high speed; B. Goldsmith, Milwaukee, Wis., 13x14 direct connected high speed; Grand Haven Elec. Co., Grand Haven, Mich., 9 & 16x14 compound condensing; Cortland & Homer Traction Company, four 11 & 20x14 compound condensing, with boilers; Steamer "Sirius," St. Lawrence River, 40 h. p. marine boiler; Steamer "Ione," St. Lawrence River, 40 h. p. marine boiler; City of Winston, Winston, N. C., two 50 h. p. R. T. boilers; Southwark Manufacturing Company, 50 h. p. R. T. boilers; Geiger, Fisk & Co., Louisville, Ky., 75 h. p. R. T. boilers.

WESTERN NOTES.

MR. J. F. RANDALL, of Cleveland, O., has been appointed electrical and mechanical engineer of the new Detroit, Mich., Railway.

THE F. W. EDMUNDS ELECTRIC CONSTRUCTION Co., is a new concern at Fort Wayne, Ind., that is doing a large amount of work in wiring, installation, &c.

MR. LOUIS B. HOWELL, Editor in chief of the Sibley *Journal of Engineering*, took advantage of a short vacation during the holidays and included Chicago in a number of cities visited.

FULTON, ILL.—C. C. McMahon, Ed. Wyatt and H. S. Rewer have incorporated the Fulton Electric Light & Power Company. The Capital Stock is $20,000.

MR. THOS. G. GRIER, one of the managers of the Bryant Electric Company, will, on January 15th deliver a lecture before the well known Fig Fag Club, Chicago. Mr. Grier's subject will be "Electricity in the 19th Century."

THE BURGESS ELECTRIC Co. of Duluth, Minn., is to make electrical fixtures of all kinds and do every variety of electro-plating. Mr. Pomeroy, receiver's agent for the Great Western Elec. Mfg. Co.. is manager.

MR. C. BOETTCHER, of Denver, Col., president of the Leadville Electric Light & Power Co. informs us that the Citizens' Light Co. of Salt Lake City has been incorporated by himself and others with a capital stock of $500,000. The Company will begin work at once and is now in the market for engines, boilers, wire, electrical apparatus, etc.

THE ELECTRIC APPLIANCE COMPANY have just closed up a very successful year's business and are starting out with renewed energy for the campaign of 1895. They have very largely increased their supply stock during the past year and have added several very desirable new specialties among which might be mentioned the line of Lynn Electric Railway material which is meeting with a large sale.

"HAPPY NEW YEAR AND KERITE WIRE" is the imprint on a neatly gotten up New Year's souvenir which S. F. B. Morse & Co. distributed among their many friends the first of the year. Those who a year ago were fortunate enough to receive a similar remembrance from the firm's predecessors, Messrs. Cushing & Morse, were no doubt pleased to find that the contents of the little box, like Kerite, were fully up to the standard, and if anything, improved in quality.

THE BRYANT ELECTRIC Co., through their western office, Chicago, promise to the trade some new and valuable specialties for the year 1895. Their ratchet 5 and 10 ampere double pole switches, the single pole railway cut out, the chandelier switch and several other specialties were all creations of the past year and all met, we are told, with the success that attends a commercial article of first class quality. Both the western managers, Thos. G. and Edward R. Grier are electrical engineers, whose training has been in the severe school of practical experience, backed by a thorough technical education. The same is true of Mr. W. C. Bryant, the General Manager, and with a personnel of this character it is not too much to expect that good things should come from this factory.

THE LOUIS K. COMSTOCK Co., the well known Chicago firm of electrical engineers, report the closing of a number of important contracts at the beginning of the new year. While the gradual revival of business in general has no doubt had a favorable effect upon the electrical trades, it would seem that a number of the orders secured by the Comstock Company were entirely due to the excellent reputation the firm has made for itself during the past years. Among the contracts recently booked we notice the following: Ft. Dearborn Building, Chicago, 2500 lights; New England Building, Cleveland, 3000 lights; Parke, Davis & Co., Laboratory, Detroit, 1200 lights; Chamber of Commerce Building, Detroit, 1800 lights; A. O. Slaughter's residence, Chicago (Iron Conduit); J. O. Armour's residence, Chicago, (Rewiring).

PHILADELPHIA NOTES.

THE BERLIN IRON BRIDGE Co., of East Berlin, Conn., have just completed a new boiler house for the Metropolitan Electric Co., at Reading, Penn.

PEPPER & REGISTER, the engineers and general contractors, have removed their offices from the Provident Building to 1414 South Penn Square, Philadelphia.

S. MORGAN SMITH, York, Pa., is now building for the Minneapolis General Electric Co., Minneapolis, Minn., two horizontal McCormick turbines each to develop 1,000 H. P. This is for the new plant being put in by that company and will be a very important installation. The water wheels are of immense proportions, each wheel with its pipe, etc., weighing about 50,000 lbs. Mr. Smith also has some other important wheel contracts for other plants and his shops are very busy on work of this class.

ANNUAL MEETING OF THE OKONITE COMPANY, LTD.

The annual ordinary general meeting was held by the Okonite Company, Ltd., at the New York office of the Company, No. 13 Park Row, Dec. 27th, Mr. Edward Lyman Short, presiding. A large percentage of the stock was represented. Reports from the heads of the several departments showed a good business transacted by the company during 1894 and substantial indications that the business of the new year just entered upon is to be still better. The meeting adjourned after re-electing the auditors.

NEW ENGLAND NOTES.

THE WARDWELL ELECTRIC MFG. Co. has recently moved into the rooms under A. R. Burpee's hosiery mill at Lakeport, N. H.

THE CLINTON WIRE CLOTH Co., at Clinton, Mass., have just completed a new boiler house. The roof is of iron, covered with the Berlin anti-condensation corrugated iron.

LINTON & SOUTHWICK of Worcester, Mass., have recently issued a neat little catalogue showing the various styles of switches they manufacture, which is well worth sending for, if in the market for that class of goods.

MAYBIN W. BROWN. There have been a number of rumors lately that Mr. Brown had resigned from the Thompson-Brown Electric Co. of Boston. Upon investigation it has been found that they are entirely without foundation, and Mr. Brown is likely to continue in his present position for a number of years.

CUMNER, CRAIG & Co., of Boston, have recently become agents for the Cutler-Hammer Manufacturing Co. of Chicago, manufacturers of all kinds of rheostats and special starting devices, and also for the Dean-Whiting Elevator Co. of Worcester, Mass., manufacturers of all kinds of elevators, both hydraulic and electrical.

MR. J. B. PHILLIPS, superintendent and electrician of the Portland Electric Works, has resigned and has formed a new Company under the name of the Maine Electric Works at 27 Commercial street, Portland, the premises formerly occupied by the Giant Motor Co. He is manager. O. W. Neal is treasurer and secretary; W. M. Lamb is president.

THE PERKINS ELECTRIC SWITCH & MANUFACTURING Co., of Hartford, Conn., have removed their New England office from the Hathaway Building, Boston, to more commodious and central quarters at 15 Federal Street. Mr. F. B. Smith, the manager of this office, has succeeded in the short time he has been in Boston, in establishing a substantial business, and is now seeking a place where he can have plenty of room, and be able to keep a considerable stock of goods on hand.

THE EDDY ELECTRIC MANUFACTURING Co. of Windsor, Conn. have recently received the contract for two 200 kilowatt generators for the Hartford Street Railway Co. of Hartford, Conn., to replace those of other manufacture which have not proved satisfactory. The Eddy Company have a number of large generators on hand, and their shops now present a busy scene, and index the sure approach of good business. Their regular motor business is also largely on the increase, and there is now a steady demand for their goods, in all the different varieties and sizes.

THE CUSHMAN ELECTRIC LIGHT Co., of Concord, N. H., has just been organized, for the purpose of manufacturing dynamos and motors under the patents of A. L. Cushman. They have bought out the Granite State Electric & Machine Co., of Concord, of which Mr. Cushman has been a partner for years, and which will now go out of existence. The officers are: President, B. A. Kimball, of Concord, N. H., treasurer, Ambrose Eastman of Boston. The new company will commence operations at once, and develop the business into one of considerable magnitude. A large number of the Cushman motors and generators are running in Concord and vicinity with marked success, and, with the new management, it is intended to introduce them to the general market.

CANADIAN NOTES.

THE WHITNEY ELECTRICAL INSTRUMENT Co.'s Canadian works at Sherbrooke, Que., were badly damaged by fire on Dec. 29. The plant and stock were damaged about $10,000, while there was insurance on about $5,000. Canadian orders will be carefully executed at the Whitney American factory at Penacook, N. H., until the Canadian works are rebuilt. Mr. C. E. Shedrick is the electrician and superintendent of the plant at Sherbrooke.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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NIAGARA TO-DAY.

THE accompanying engravings, reproduced from photographs, show the actual conditions of the work at Niagara of which we have already described many features. Fig. 1 shows the exterior of the power house with the inlet canal and Fig. 3 gives a view of the interior, exhibiting the base of two of the great 5,000 H. P. alternators in position.

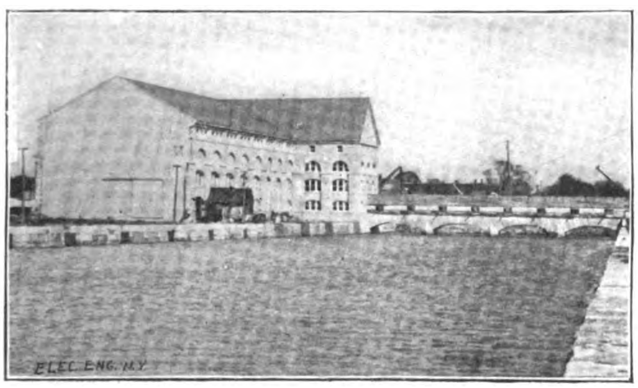


FIG. 1.—THE POWER HOUSE.

The first of these machines as erected at the shops of the Westinghouse Company in Pittsburg is shown in Fig. 4 and it may be of interest to recall the details of its construction given in our issue of Sept. 26, 1894. The sectional view of the machine shown in Fig. 2 will serve to make the description clear.

To a circular foundation is bolted a vertical cast iron cylinder, provided with a flange on which the stationary armature rests. The inner part of the cylinder is bored to the shape of an inverted cone and serves as a bearing for another conical piece of cast iron, supporting the shaft-bearings. The armature core is made of thin, oxidized iron plates, held together by 8 nickel-steel bolts. In the outer edge of the plates are 187 rectangular holes to receive the armature winding.

The outer rotating field magnet consists of a wrought steel ring to which are bolted the 12, inwardly projecting, massive cast iron polepieces. The ring constituting the field magnet is supported by a six-armed cast-steel spider keyed to a vertical axis. The field-magnets act also as a flywheel. The shaft rests on two bearings supported by four arms projecting from the inner adjustable cast-iron cylinder. The bushings of the bearings are made of bronze provided with zig-zag grooves in which oil constantly circulates. On the outer side of the bushing there are also grooves into which cold water may be pumped, if required.

The armature-conductors are rectangular copper bars 32 x 8 millimetres and each of the 187 holes of the armature contains two of these bars, surrounded with mica. The upper and under sides of the armature are connected by means of V-shaped copper bars, riveted to the ends of the bars which project out behind the ends of the armature. The connections are made so as to give two independent circuits, a pair of cables connecting each circuit with the switchboard. The magnet-winding is also composed of bent copper bars, air-insulated, inclosed in brass boxes, two of which are fastened to each pole-piece. Continuous current for exciting the field magnets is obtained from a rotary transformer.

The current is conducted to the field coils by means of a pair of brushes and two copper rings fixed to the top of the shaft of the generator. At a speed of 250 revolutions per minute the machine produces two alternating currents, differing in phase 90 degs. from each other, each of 775 amperes and 2,250 volts pressure. The alternations are 50 per second. The height from base of bed plate to top of machine is nearly 13½ feet.

An interesting letter summing up the situation, from Prof. George Forbes, has recently appeared in the London *Times*. We reprint it below:—

"Nearly three years ago you published a letter from this place in which I gave some account of how the dreams of the engineer were in the act of being realized, and without injury to the natural beauties of the spot. Three years have passed, my work is ended, and it seems natural to continue the narrative and tell what these three years have brought forth. I am perched on the top of a small Eiffel Tower, lately erected, and, casting my eyes up the river, over the housetops and beyond the town, I see a new world created. There is a wide canal leading water into that gigantic power house where three turbines are set up to drive three dynamos of 5,000 H.P. each. There is the bridge to carry cables across to the transformer house. Inside the power house the water is carried down pipes 7½ ft. diameter into the turbines, and then it passes through a 7,000 ft. tunnel under the town, emerging below the Falls, and capable of developing 100,000 H.P. Far as the eye can reach extend the Company's lands, with here and there a huge factory either now using the water-power, or waiting for the electric supply. One of them uses 3,300 H.P., another 300, a third one 1,500, and that unfinished mill requires 1,000. You can see, far away, the model village for working men, and improved sewage works with drainage, pumps for water supply, electric light, and well-paved streets. There, again, is the dock where ships from all parts of the great lakes can unload, and there a huge expanse of reclaimed land; while the whole is swept by the Company's railway, seven miles long, connecting every factory with the great trunk lines. The power is transmitted by electricity, and the

The Tunnel Outlet.

first work is to produce aluminum with 1,500 H.P. New types of machines have been devised for this work, as also for every other purpose. All criticism as to cost of electric works has been swept away by the results achieved, and the efficiency of each type of machine is greater than has been attained before. All the machinery for the first

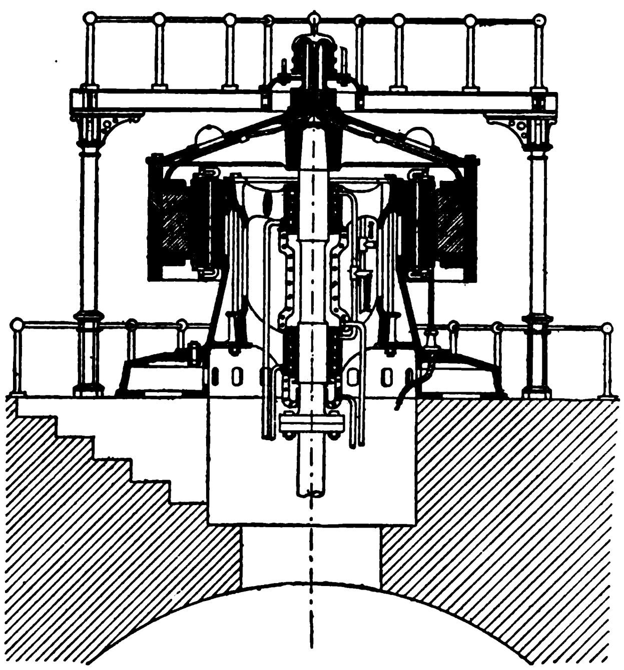


FIG. 2.—NIAGARA 5,000 H. P. TWO-PHASE ALTERNATOR.—SECTION.

working has been made and tested in the shops, and the last parts are now being set up. The plans for carrying the power to Buffalo, 18 miles distant, are complete. In a month or two factories will be in full operation; in a year Buffalo will be supplied; in two years the same company will be working the Canadian side of the Falls, and in ten

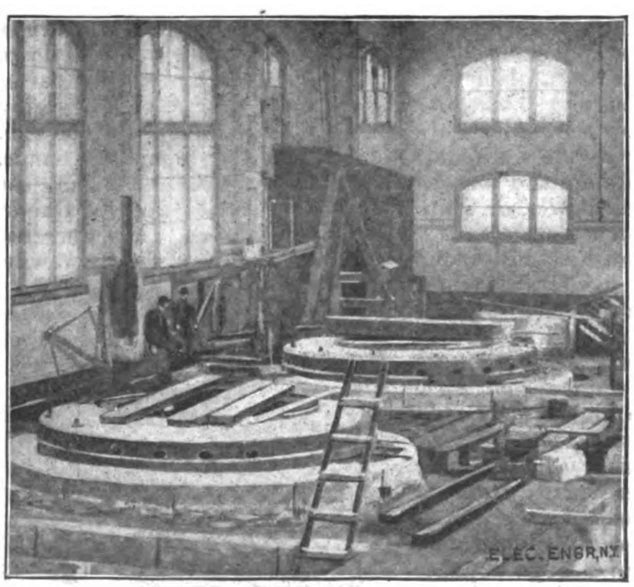


FIG. 3.—VIEW OF INTERIOR OF THE NIAGARA POWER HOUSE.

years (shall we say?) the whole of the 100,000 H.P. which can be supplied by the existing hydraulic works will be giving power to smokeless manufacturing towns. The period of planning the transmission scheme, of designing the greatest dynamos in the world, and of construction of the first plant now closes. The financial period commences with the new year. The earning of dividends and the ordering of duplicate machinery is the future work of the company. In conclusion, it is difficult for me to say who were the boldest, the capitalists who embarked on the scheme before any plans were matured, or the manufacturers who moved their factories to this field before a single result had been achieved. The action of both was typically American, but their confidence was not misplaced. Their success is now assured."

The turbines built by the I. P. Morris Co., are in position and all the galleries, the ladders, the elevators and the electric lights have been placed in the wheelpit.

Men are now at work putting in the turbine oiling apparatus, with the tanks, filters, pipes and pumps. A novel way of operating the force pumps which take the oil up through the pipes to the upper tank has been developed. All the water which leaks into the wheelpit is collected by a ring around the pit into a reservoir about a third of the way down the pit and is used to run the

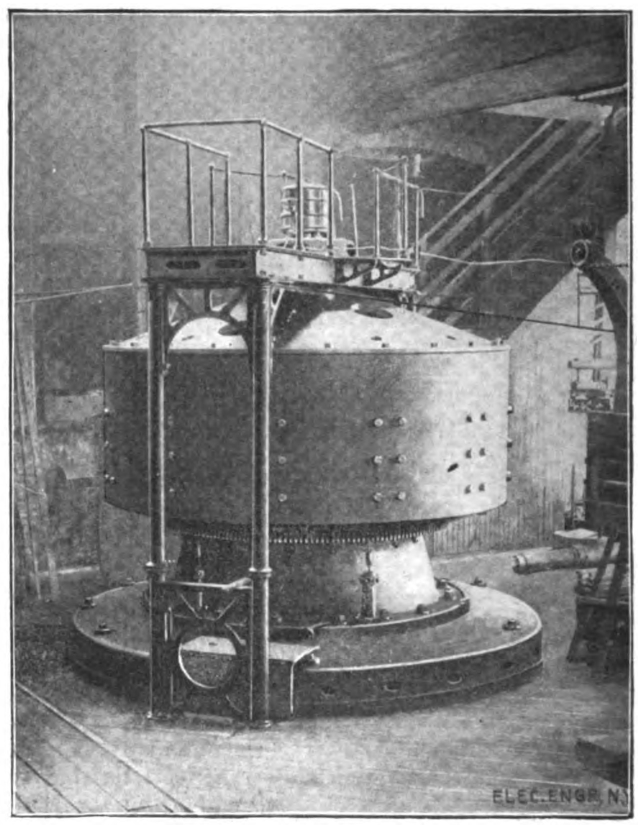


FIG. 4.—NIAGARA 5,000 H. P. TWO-PHASE ALTERNATOR.

pumps. A pressure of 90 pounds to the inch is secured by this surplus water.

The main switch-board room in the power house is also well under way. It is to be constructed of white enameled brick and when finished will be 58 feet long, 13 feet wide and 8 feet high. The front will be composed of 10 heavy plate-glass windows, while the top of the inclosure will be an observation platform, inclosed in a brass railing, for visitors. This room will contain some of the heaviest switches thus far constructed and will be one of the most interesting features of the power plant.

The transformer building which stands over the mouth of the electric subway is also well up to the roof. It is of the same style of architecture as the main power building, massively constructed.

It will thus be seen that within probably one or two months the dynamos at Niagara will be running and what must be considered to be one of the greatest engineering works in the world will have become an accomplished fact.

THE POSTAL TELEGRAPH COMPANY IN THE WEST.

BY

George Heli Guy.

In a somewhat extended trip through the West no class of progress has been more persistently forced on my attention than that of the operations of the Postal Telegraph Company. In every place there is the same report: The service is popular, and the business of the office is steadily on the increase. The little town from which I am now writing, Santa Ana, Cal., is situated in the centre of a fruit growing community. Its permanent population is about 10,000, but it has a constant flow of visitors in search of health or desirable fruit properties. The Postal business here has almost doubled in the last two years, under the superintendence of Mr. E. N. Gray, who informs me that during the last six months a still further improvement has set in, and been steadily maintained. Much of this prosperity is doubtless due to the fact that the Postal Telegraph office is placed in the lobby of the Brunswick, the best hotel in Santa Ana, and the one to which every one goes, as a matter of course. This gives the office all the transient trade, in addition to its local business.

Happening to call at the Postal Telegraph station at Albuquerque, New Mexico, a few days ago, I was hailed by a familiar voice from behind an operating table, and was soon exchanging greetings with Mr. Minor M. Davis, who, on a westward tour had called at Albuquerque to superintend the installation of Chloride accumulators, which supply current for the new Postal circuits now being put in operation between Chicago and San Francisco, over the route of the Santa Fé and Atlantic & Pacific Railroads.

This plant possesses special interest from the fact that it is the first large telegraph plant of the kind that has been installed in this country. In other words, it is the first telegraph office that is entirely dependent upon this service. The plant consist of 360 chloride cells, 6 inches by 6 by 2, divided into nine sections for convenience in charging. The cells have a capacity of 20 ampere hours, at the rate of discharge called for by the service. In addition, there are 12 cells of 100 ampere capacity each, for supplying local current, the smaller cells doing the main line work. The plant is remarkably compact. The cells are placed on two racks, each having three rows of double shelving, the highest row being 4 feet 6 inches above the floor. Access may be had to the cells from either side of the rack, and the floor space occupied is 13 by 5 feet. Each section of the battery is provided with a fuse arranged to blow at a point that will afford ample protection from harm due to shortcircuiting, or abnormal increase of current. The tests of the plant have been most satisfactory, and as nearly as can be at present determined, they indicate an efficiency of 75 per cent.

The advantages of this over former methods under certain conditions, are manifest. It will cost less to supply current at such a station as Albuquerque than it would with Callaud cells, the battery uniformly used in this country for telegraph work, while the construction of more circuits when needed, will add very little to the cost of operation. For instance, to do the work that the accumulator plant is capable of, some 800 cells of Callaud battery would be needed, and should any additional circuits be required, that number would have to be greatly augmented. As a matter of fact, with the present plant, all that would be required with an increase in the number of circuits, would be to use the same number of cells, but to charge them more frequently. This plant seems to fill the hitherto vacant place between the Callaud battery and the dynamo for telegraphic work, and its success will doubtless lead to a new departure in many telegraph stations where there is not enough business to justify the installation of a dynamo, and yet too much to allow the Callaud battery to be used economically.

Mr. F. W. Jones, the electrician of the Postal Telegraph Company, has been investigating this subject for some months, in connection with the operation of an experimental plant of the company in Baltimore. The results of Mr. Jones's tests reveal some interesting figures. The charging current is taken from the local lighting company's incandescent circuit, and is controlled by dynamo regulators. The cells are charged to an E. M. F. of 2.5 per cell, and discharged to about 1.8. The cell in use maintains a pressure of about 2 volts through its entire run. It might be thought that such service would entail too great a variability of pressure; but, as a matter of fact, the lowering of the voltage from 2.5 to about 2 volts, which takes place shortly after the cells are put to work, goes no further, and a pressure of about 2 volts is maintained through the run. This, at all events, is the result of the tests that have so far been made at Albuquerque.

The cells discharge through resistances to prevent any danger of shortcircuiting, and the subdivisions of the battery are controlled by single and double-throw switches, similar to those used in electric light work. Not the least advantageous part of the installation is the system of switching devised by Messrs. Jones and Davis, whereby any defective section of mains or locals, can be instantly released, and an entire section substituted, the defective section being put in order at leisure. The batteries are made by the Electric Storage Battery Company, Philadelphia. The Weston voltmeter and ammeter is used; the regulators are from the Crocker-Wheeler Company, and the resistance coils are supplied by the Western Electric Company. Mr. W. H. Mills is in charge of the office.

Albuquerque, like many other frontier stations has been the scene of strange experiences in the early days of telegraphy. Mr. C. M. Baker, the well known superintendent of construction of the Company, tells of a half-hour replete with new sensations that he once passed in this neighborhood. About that period it fell to his lot, while constructing new lines, to arrange for right of way privileges. This was often a tedious and comparatively uneventful task, but on the occasion in question the monotony was relieved by an entirely novel programme. Mr. Baker had encountered a batch of Indians of the toughest type. As soon as he stated his terms, they jumped on their horses, and with unearthly yells, began careering at full speed around the baggage car in which Mr. Baker sat alone in the desert, and fired their six-shooters alternately in the air and under the car, thinking to "take a rise out of the tenderfoot," and to scare him into a better bargain at the same time. Mr. Baker, however, lit a cigar, placidly went on smoking, and looked as if he had been yearning for that sort of thing from childhood. When the Indians saw it was of no use, they again came down to bargaining, and eventually Mr. Baker made a satisfactory settlement, though he confesses that for a while he regarded appearances as dead against him.

NEW STATION FOR NEW YORK CITY.

The new power station for the United Electric Light & Power Co., on West 28th street, New York, is now being put in place by the Berlin Iron Bridge Co., of East Berlin, Conn. This will be a model station and one of the most complete and perfect in the Eastern States. The engine and dynamo room is 100 feet square and the boiler room 60 feet by 100 feet. The roof covering on the dynamo room is to be the Berlin patent anti-condensation corrugated iron. The coal pockets in the boiler room will have a storage capacity of 8000 tons of coal.

PROPOSED ELECTRICAL TRANSMISSION OF POWER FROM SNOQUALMIE FALLS, WASHINGTON.

SOME two years ago it was first proposed to utilize the Snoqualmie Falls in Kings County, Washington, 28 miles east of Seattle. The originators of the idea have not been idle, and have now come out with a definite plan for carrying through the work. This fall is the largest water power in the state and the most advantageously situated for inexpensive development. It is 286 feet in height—108 feet higher than Niagara—and its theoretical energy has been estimated at 51,607 H. P.

The idea of utilizing this valuable power to transmit electricity to Seattle and the neighboring suburbs has been well received by capitalists and the Snoqualmie Falls Electric Power Co. has been formed to carry it out. The company has acquired a tract of 350 acres of land on both sides of the river and intends to develop and deliver 5,000 H. P. at Seattle, where about that amount of power is now generated by steam at a cost of over $60 per H. P. per annum and is used for electric lighting, electric and cable railways and manufacturing establishments. The Westinghouse company, has, it is stated, offered to furnish the plant complete, ready to run, and including the conductors between the falls and Seattle for $350,000. The largest electric lighting and power company in Seattle has offered to purchase its entire supply of electricity from the Snoqualmie Falls company, at a price which, it is said, would pay the interest on the bonds and a dividend on the stock of the latter company. The acceptance of this offer alone would thus assure success.

The company has estimated that if it can sell in Seattle but 3,000 H. P. of the 5,000 H. P. now used there, and at $30 per H. P. instead of the $60 now paid, the income will be as follows:

3,000 H. P. at $30 per annum		$90,000
The expense of maintenance and operation, owing to the delivery of power to one consumer only, will be very small and is estimated at $10,000. If we allow $5,000 for unforeseen expenses the annual expense will be	$15,000	
Interest on $650,000 5% bonds	32,500	
Total interest and charges...	$47,500	47,500
Leaving a surplus of		$42,500

equal to nearly 3 per cent. on the $1,500,000 stock issued.

This is a minimum showing and is based on "hard times" conditions and on the sale of the power at one half the present cost to the consumers and supposing them to take much less than now actually used in Seattle. At the great reduction in price which the company offers, the amount of power sold is expected to be fully as much as now used and probably more. The sale of the 5,000 H. P. now used in the city at half the present rates, or $30 per H. P., would net the company over 6% on the stock.

This estimate is made on Seattle alone and does not include the demand from Tacoma, Everett and adjacent territory.

The city of Everett can, it is said, be connected with the lines of the company at a cost of less than $20,000. About 1,500 H. P. is now used and the cost of power is greater than at Seattle. The sale of power at Everett would thus give the company an additional revenue of $30,000 to $45,000 annually. A number of large manufacturing plants are situated there, including a pulp and paper mill, nail mill, barge works and a smelter, and there is also an electric lighting plant and street railway. The city of Tacoma, which has nearly as large a population as Seattle, could be connected at about the same expense as Everett and would probably use as much power as Seattle. It is thought that there is little doubt, from the above basis, that in the first year of the operation of the company's plant, the entire first installment of 5,000 H. P. can be sold, and that the growth of the city whose present population is over 65,000, and the increase of manufacturing industries, will soon require the development and transmission of another 5,000 H. P. The opportunity to get cheap power will induce manufacturing plants to locate at the falls where the railroad facilities are excellent, and the company is already receiving applications for such locations.

Along the line of transmission are a number of large coal mines. These mines use for pumping, hoisting and lighting over 1,000 H. P. which they generate by the use of their own coal. The superintendent of one of these mines has offered to take their power from the Snoqualmie Falls Electric Power Company at $30, the regular rate of the company, saying that it will pay them to use it as the cost will be no greater than at present and the danger from fires and hot steam-pipes will be avoided.

The estimates of cost given include excavations and rock work for the development of 15,000 H. P. as well as the actual development and transmission of the 5,000 H. P. on which present earning power is calculated. The company does not intend to distribute electricity itself, but to sell all current used in Seattle to the Union Electric Company or to the new consolidation of all the Seattle electric companies, of which the Union Electric is the controlling company. The same plan will be pursued in other places.

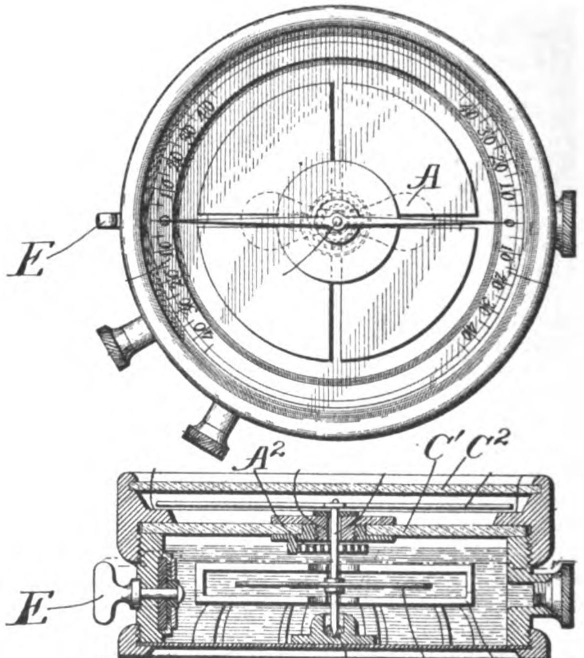
The surveys and construction estimates have been made by Reginald Thompson, chief engineer of Seattle. The electric plant estimates by the Westinghouse Company and the Stanley Electric Company and the hydraulic machinery by the Pelton Water Wheel Company.

Mr. R. M. Smythe, of 452 Produce Exchange, New York City, to whom we are indebted for much of the data, may be addressed for further particulars.

PROF. ROWLAND'S ELECTROSTATIC VOLTMETER.

It is well known that the electrostatic forces between bodies are greater in proportion to the specific inductive capacity of the surrounding medium. Furthermore, the spaces between the attracting bodies can be made smaller in a liquid where the insulation is greater than in air, and thus the forces can be still further increased. Again, the moving parts of an electrometer can be made to float in a liquid, while the viscosity of the liquid will damp the motion of these parts, and so prevent excessive vibration, and also bring the needle earlier into a position of rest. Having these facts in view, Prof. Henry Rowland, of Johns Hopkins University, Baltimore, has recently devised a very sensitive electrometer the working parts of which are immersed in a non-conducting liquid. While the moving parts are perfectly free to move, they can not oscillate to any extent, and will come to rest in a perfectly periodic manner. Furthermore, as all the delicate parts are materially buoyed up by the liquid, the instrument is not likely to be injured by rough treatment.

The instrument will be readily understood by reference to Figs. 1 and 2, where A represents the needle or equivalent part



FIGS. 1 AND 2.—PROF. ROWLAND'S ELECTROSTATIC VOLTMETER.

which is moved by the electro-static forces, and operates the pointer A^1 causing it to move along the scale. The case is provided with two glass covers C^1 and C^2, in the lower one of which a spindle revolves freely, resting upon an anti-friction bearing near the base of the instrument. The pointer swings over a graduated arc in the air space between the two glass covers. A small air space is also left beneath the inner glass cover to allow for the expansion of the inclosed liquids, and the needle A is moved against the tension of a spring.

Prof. Rowland uses any liquid of sufficient insulation and high specific inductive force, such as the various kinds of oil, either mineral, animal or vegetable, the oil of turpentine, bisulphide of carbon, chloroform, the various kinds of ether and alcohol, and for measuring low voltage, even very pure water.

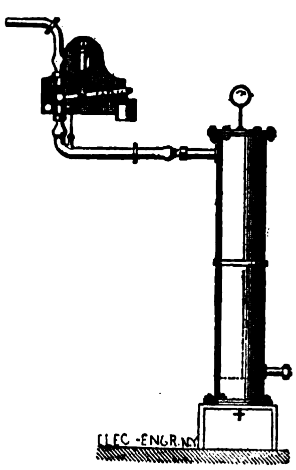
TELEPHONY.

AIR CIRCULATION LEAD CABLES.

Towards the end of 1891 a 6-conductor cable running from the Stock Exchange to the Montparnasse railroad station in Paris, became defective. It was ascertained that the lead sheath had been pierced by rats and that dampness had penetrated into the cable, which had caused its insulation resistance to fall to less than one megohm per kilometre. The hole was stopped by soldering, but this did not remedy matters much, as it was soon recognized that it would be necessary to take out a cable section of 200 metres length, in order to obtain satisfactory insulation. It then occurred to M. A. Barbarat that by passing a current of dry air through the whole cable he could get rid of the dampness and thus raise the insulation resistance of the cable to its original value, which had been 5,000 megohms per kilometre. This was tried and at the end of 88 hours the section of 200 metres, which had been filled with water, had a resistance of 8,000 megohms, or 600 megohms per kilometre. The first part of the experiment having succeeded, it was evident that the entire cable could be dried. The work was then proceeded with on the other section and at the end of 41 hours the insulation of the cable was 12,500 megohms per kilometre; that is to say, far higher than the insulation at the time the cable was laid.

This process has become a part of the regular methods of cable repair. It has been employed on nearly all the cables where they have been accidentally impaired, and also to increase the insulation of the older cables having wooden plugs covered with rubber. At the present time the air circulation is kept up by utilizing the compressed air plant used for the pneumatic transmission of messages from the Stock Exchange to outlying parts of Paris. Besides its other advantages it allows a break in the lead sheath to be found very easily. The inspector follows the cable in the sewers and the whistling of the compressed air as it escapes from the interior of the cable indicates the break. At the same time, by using compressed air, the danger is avoided of drawing in damp air, which would be the case if the vacuum method of air circulation were employed.

The apparatus for drying the air consists of six cylinders of the type illustrated in the accompanying engraving. They are made of sheet iron 5 millimetres thick, 200 millimetres interior diameter, and 1.2 metres high. The cylinders are closed at the top and bottom by plates bolted to flanges. In each cylinder there is a grid .2 metre from the bottom, and all the space above, that is, 1 metre, is filled with calcined chloride of calcium, that is, about 15 to 20 kilograms, according to the density of the chloride. A stop-cock at the bottom permits the discharge of the



DRIER FOR AIR CIRCULATION CABLES.

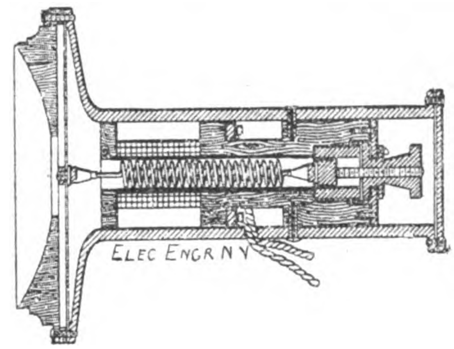
chloride dissolved by the humidity which is absorbed. The last of these six cylinders, through which the air passes, is not entirely filled with chloride. The space above the chloride, 0.3 metre in height, is filled with wadding in order to filter the air and to catch any of the chloride dust which might be carried over. A ball of sheet metal perforated with fine holes is screwed into the tube which leads to the cable, in order to prevent the entrance of cotton. The pressure regulator equalizes the pressure of the air which is metered, and a gauge is screwed on to the first column.

The compressed air is obtained from the Popp system of compressed air distribution in Paris, at a pressure of 5 kilograms per square centimetre. This pressure is too strong and the regulator reduces it to between 1 and 3 kilograms per square centimetre. It is not safe to go beyond this limit.

Paraffine cables will no longer be used in Paris, but it is proposed to use paper cables with the new system of dry air circulation. One advantage which is considered to be very important is the ease with which repairs can be made. No precautions need hereafter be taken to keep out moisture when making joints as these are rapidly dried out after the cable is closed. M. Barbarat expresses the opinion in the *Annales Télégraphiques* that henceforward air circulation cables, as he calls them, ought entirely to replace all other cables insulated with gutta percha or other dielectrics laid in sewers or underground.

THE OHNESORGE TELEPHONE.

Herr W. Ohnesorge, of Frankfort, Germany, has brought out a telephone presenting some novel features. Telephones with wire cores have hitherto been distinguished for their precise working,



THE OHNESORGE TELEPHONE.

but have had the disadvantage of rendering sounds very faintly. Herr Ohnesorge discovered that if the spiral iron wire forming the core project from the coil by a certain amount, the strength of the sound is increased in a manner quite out of proportion to the difference in position. The discovery is utilized in the instrument, of which the annexed cut taken from the London *Electrician* shows the details.

The spiral spring forming the core is of steel or iron wire, thoroughly hardened, and with the turns just so far apart as not to touch. This spring is of such a size as to permit free movement of the bobbin, inside the tube without touching the sides, and is made of wire 1 mm. in diameter. The front end is fastened to a sounding board in front of the telephone, while the back end, projecting behind the coil by about the length of the latter, is fastened to an adjustment screw, which regulates the tension on the spring. Such an instrument speaks loudly and clearly, and renders song or musical tones perfectly. Steel wire speaks less loudly than hardened iron wire, and magnetizing the spring also increases the volume of sound; the latter course is necessary if the instrument is to be used as a transmitter. It is found that if in the centre of the spring, or at several equidistant points the adjacent turns are more widely separated than the average, the sound is also increased, and the spring appears to oscillate sidewise as well as longitudinally; and the same effect is produced by putting the spring skewed in the coil. The telephone is very simple, cheap, and easily regulated.

TELEPHONE NOTES.

FOREST CITY, IA.—A telephone system has just been completed.

BRATTLEBORO, VT.—A petition is being circulated with a view to getting better telephone service.

WABASH, IND.—The Phenix Telephone Company, of Indianapolis, has been granted a franchise in this city.

ALBANY, N. Y.—Assemblyman Gerst of Buffalo, has again introduced his bill for the regulation of telephone charges.

PRESTON HOLLOW, N. Y.—A company has been formed at Preston Hollow to operate a telephone line from Middleburg to Oak Hill.

SEATTLE, WASH.—The Sunset Telephone and Telegraph Company is revising its schedule of long distance rates and has very materially reduced them.

ST. JOSEPH, MO.—The Harrison International Telephone Company's system will be used by the Citizen's Telephone Company at St. Joseph.

KANSAS CITY, MO.—The Inter-State Telephone Company of which C. B. Riley is president, George McLean secretary and George J. Twiss general manager has a capital stock of $100,000.

MILTON, N. Y.—The West Shore Telephone Company are extending their lines so that later on every village in Ulster county will be connected by wire.

KNOXVILLE, TENN.—The People's Telephone and Telegraph Company has completed a new exchange here, with 500 subscribers. The new company will enter the field against the East Tennessee Bell Telephone Company.

VERGENNES, VT.—The Vergennes Telephone Company, the members of which are F. H. Foss, F. W. Tuttle and F. M. Moulton of that city, are making the necessary preparations for starting up the business in the spring.

FLINT, MICH.—An ordinance has been presented to grant to the Flint Harrison Telephone Company the right to construct, erect and maintain an electric telephone and telegraph plant in the city of Flint.

LOWELL, MASS.—The New England and Erie Telephone Companies are spending fully half a million dollars each in the extension of their facilities in all directions. The long distance system the coming summer will be extended to St. Louis, Minneapolis and St. Paul and possibly to Montreal and Quebec. The extensions to Davenport and Omaha are not far away. Should the system be extended from St. Louis to Little Rock, about 350 miles, with the completion of the Erie system in the southwest it would be possible to talk from Bangor, Maine to Galveston, Texas.

NEW YORK, N. Y.—Senator Parsons has introduced a bill in the Senate lowering the charges of the telephone companies in the various cities of the State. In New York he would have subscribers pay $78 a year, in Brooklyn $66 a year, in Buffalo, Rochester and Albany only $48 a year, and in other cities $36.

NEW CASTLE, IND.—The New Castle council has awarded a franchise to a company headed by Charles Harriman and Robert Cokefair of Anderson for a telephone service. It is to be in within 90 days and the 100 telephones subscribed are then to be all in working order.

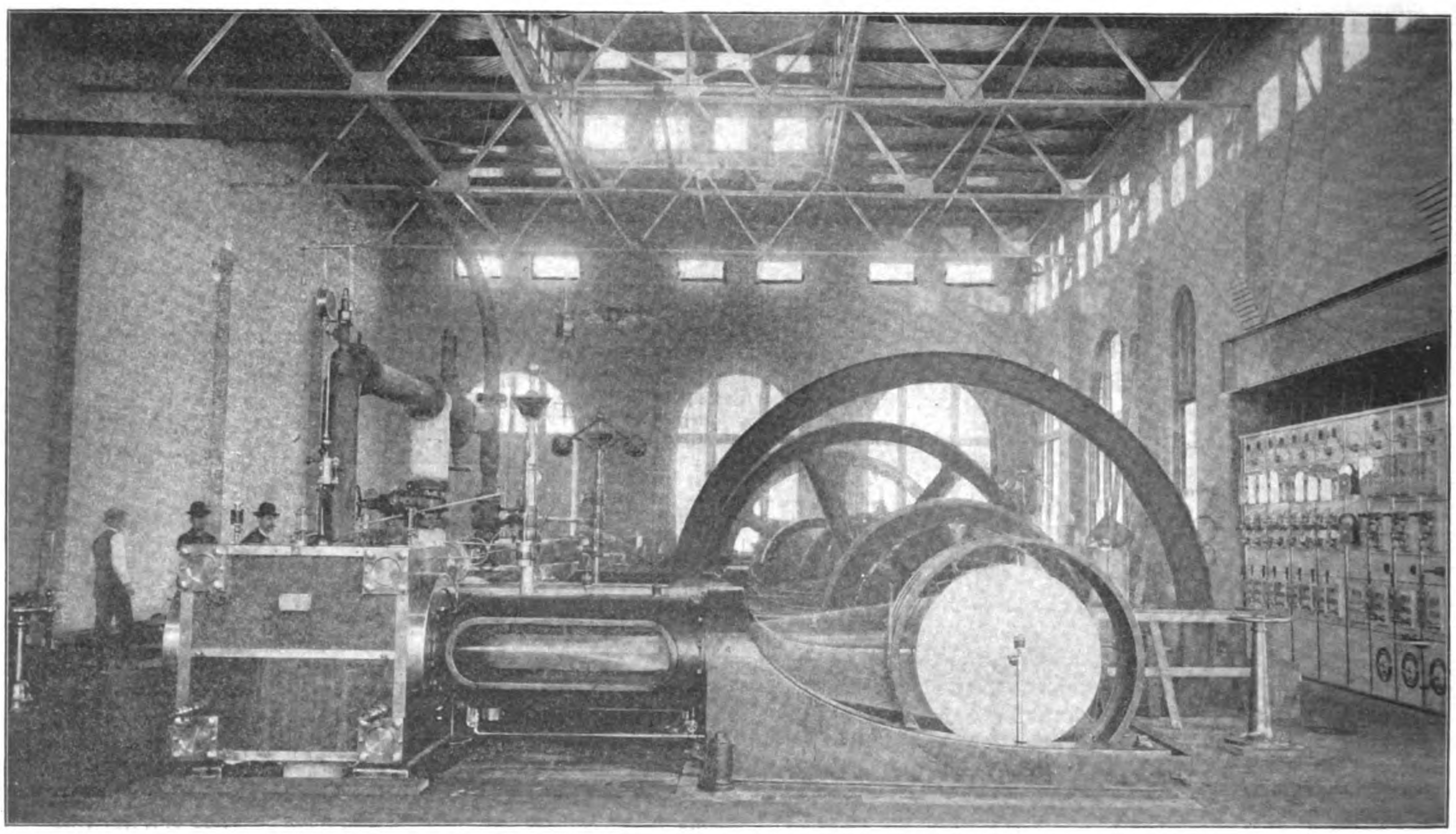
BRIDGETOWN, N. S.—A new company to be known as the Central Telephone Company (limited) has been formed. Their lines are to extend along the line of the Nova Scotia Central Railway from Bridgewater to New Germany, with power to extend to Middleton, in the county of Annapolis. The capital stock of the company is $3,000.

ELECTRIC TRANSPORTATION DEPARTMENT.

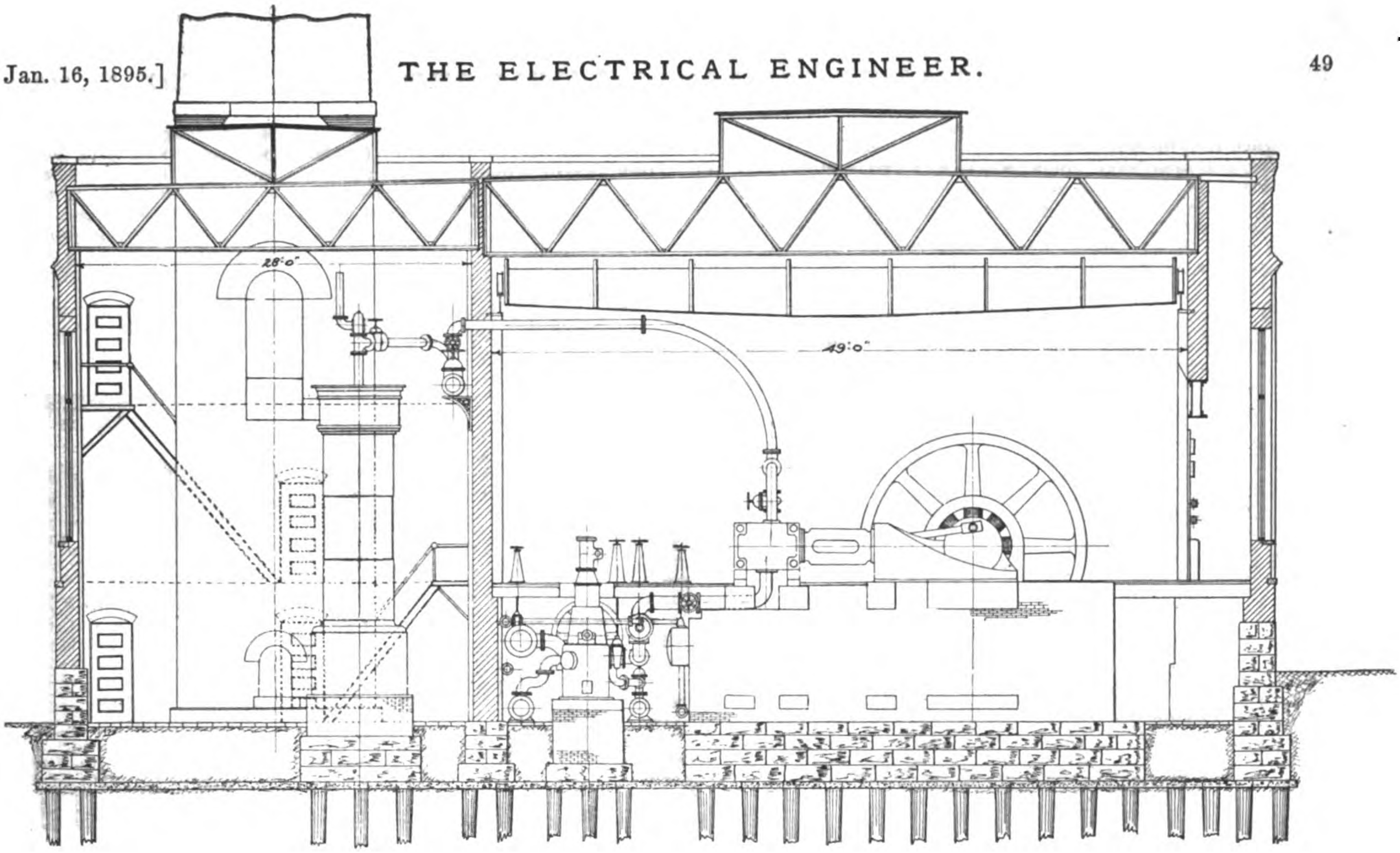
THE SYSTEM AND POWER HOUSE OF THE FAIRHAVEN AND WESTVILLE RAILROAD, NEW HAVEN, CONN.

FEW examples of recent electrical engineering are more worthy of note, in point of completeness and excellence of design, than the new power house and track equipment of the Fairhaven and Westville Railroad, of New Haven, Conn. The work of construction was supervised by Messrs. Sheaff & Jaasted, of Boston, who took the matter in hand last spring and turned on the current early in November. All the details of the plant have been carried out in a masterly manner and a brief description of the building and its equipment cannot fail to be of interest.

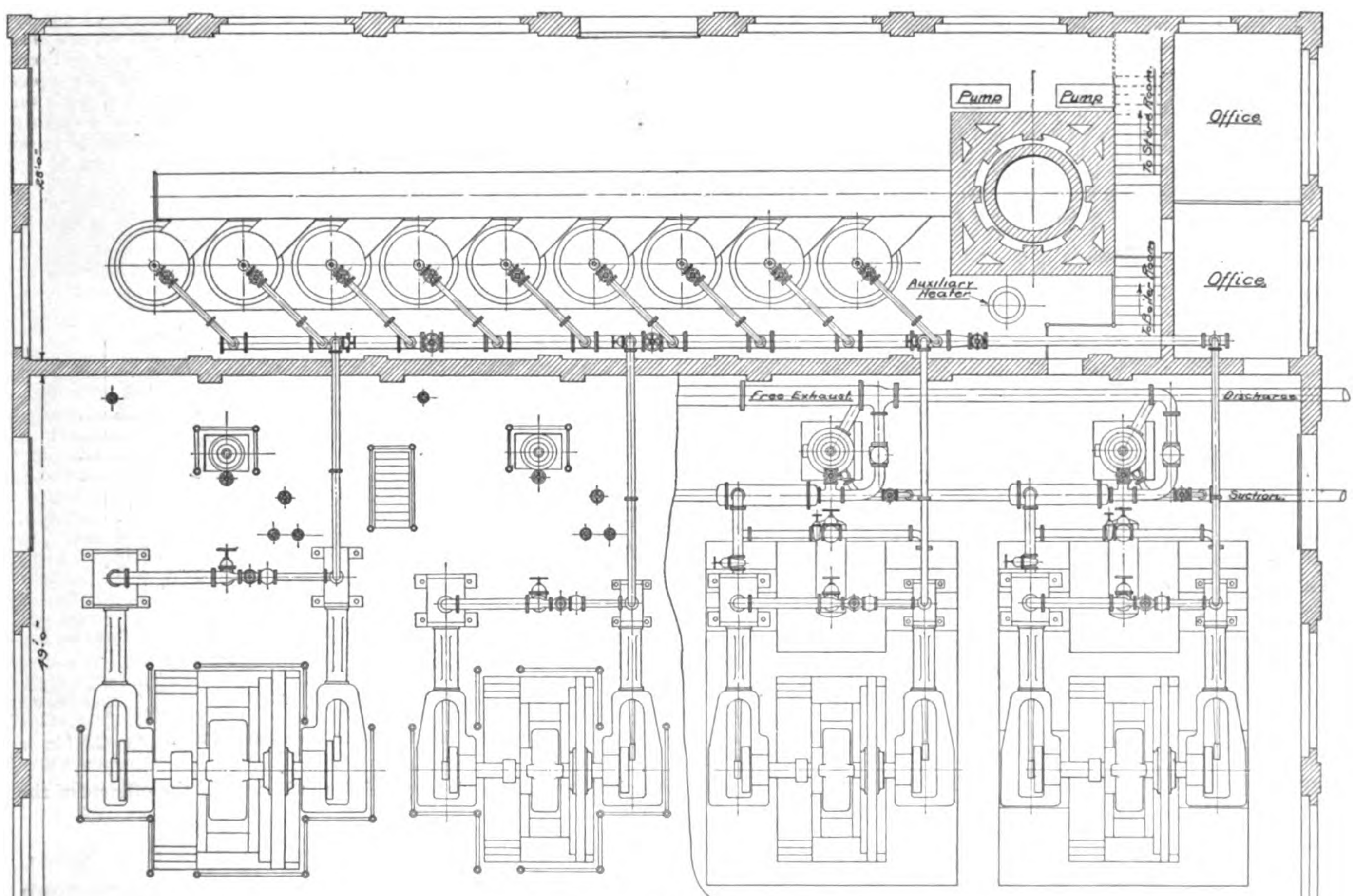
The power house is situated on the Mill river and Grand avenue, and is 118 feet long by 82 feet in width. The chimney is 140 feet high and 6½ feet inside diameter. The foundation is of piles driven in some cases to a depth of forty feet, cut off one foot below the low water line, filled in with concrete and capped with stone. The general arrangement of the interior is shown in the illustration on this page, and in plan and sectional elevation on page 49. The boiler room is 97 by 28 feet, and is equipped with Manning boilers installed by the Bigelow Company of New Haven. Where the smoke flue enters the chimney is the main damper, attached to which is a Spencer regulator controlling the draft. The boilers are supplied with water by duplicate Knowles pumps so piped that they may be used for fire purposes if necessary. Goubert heaters are placed in the exhaust pipes between the engines and condensers, and the exhaust steam from the condensers and pumps is piped into an auxiliary heater in the boiler room. In the main heaters the feed water reaches a temperature of about 120 degrees, which is increased to 200 degrees by the auxiliary before reaching the boilers. Three different ways of



DYNAMO AND ENGINE ROOM; FAIRHAVEN AND WESTVILLE RAILROAD, NEW HAVEN, CONN.



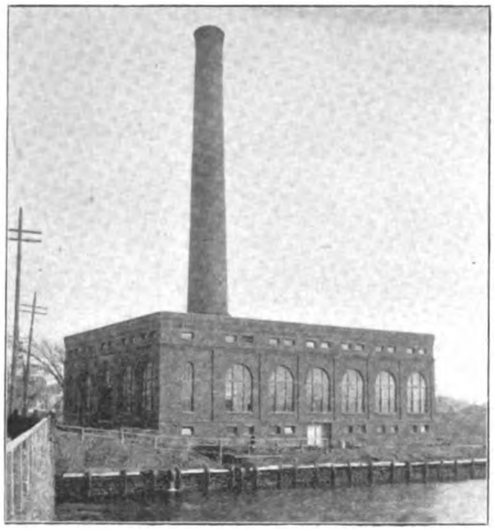
Section of Power House; Fairhaven and Westville Railroad.



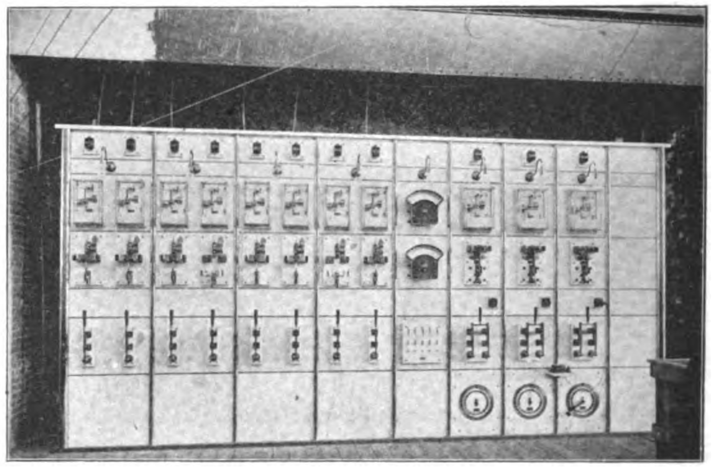
Plan of Power House; Fairhaven and Westville Railroad.

feeding the boilers have also been provided. The steam piping is so designed that no accident to any part can render the plant inoperative, and long, easy bends have in all cases been employed to the exclusion of short turns and right angle elbows.

The capacity of the plant will be when complete as designed, 2,000 H. P., although at present but half of the total number of engines have been placed. These were furnished by the E. P. Allis Company, of Milwaukee. The cylinders are 16 and 30 inches



THE POWER HOUSE.

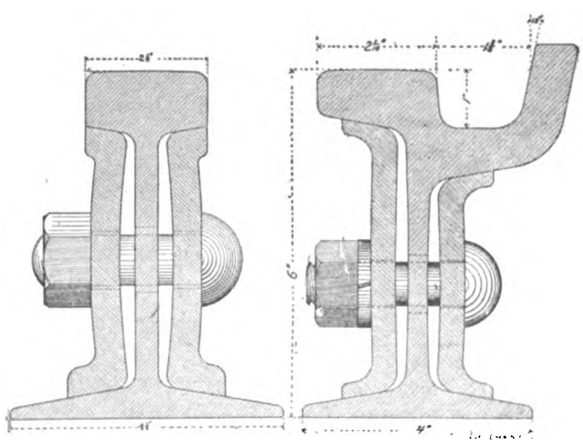


THE MAIN SWITCHBOARD.

in diameter by 36 inches in stroke, and the rated H. P. is developed at a speed of 90 revolutions per minute. An Allis fly wheel vertical jet condenser is provided for each engine. A view of the engine room is given on page 48.

The generators are Westinghouse machines of 300 kilowatt capacity, and are directly connected with the engines. The switchboard, shown on this page, is of white marble with brass trimmings and was built and equipped by the Westinghouse company. It will be noticed that it occupies no space in the engine room proper, but stands flush with the wall in a recess built for the purpose, into which the wires are led from without, passing downward through a flue to the back of the board and never entering the room at all.

The track work is especially worthy of note, particularly the

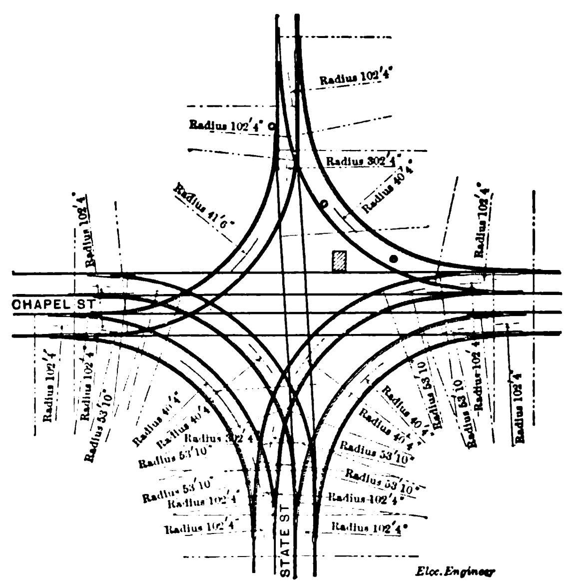


GUARD AND TEE-RAIL SECTIONS.

intricate piece of special work at the intersection of State and Chapel streets, shown on this page. This was made for the company by the Pennsylvania Steel Company, of six-inch rail throughout. The guard rail used is standard, six inches in height, and the straight track rail is six inch tee. Sections of these rails are shown on this page. The work was made of six inch rail, because at the time it was manufactured, there was no seven inch guard rail made. Had there been, the work would have been made of seven inch construction throughout, to correspond with the straight track.

The tongue switches in this work are built up switches of standard pattern. The mates are all of steel cast in one piece, and connect with the abutting rail by the same splice bar that is used with the track rail. The frogs are built up, with the exception of two, each of which is made of one steel casting, reducing the number of pieces necessary (without counting bolts and nuts) from twelve, which there would have been had these frogs been built, to one. All the tongue switches are of 100 feet radius, and it will be noticed that easement curves are used in all cases. In these curves the large radius at the entering and leaving points, and the smaller centre radius gives a very much easier riding and safer curve than could be secured by the old method of making the curves of one radius from tangent to tangent.

The road is at present operating about twenty cars with Westinghouse equipments, and others are being added as rapidly as possible. There are 36 motor cars with 18-foot bodies, very high windows, double automatic doors and all improvements, built by the Jackson & Sharpe Co., of Wilmington, Del. There are also three electric sweepers, two built by the Lewis & Fowler and one by Brill. Besides these the company has retained 28 open and 30 closed horse cars used as trailers. The work, both on the power house and the track has been done in a thoroughly scientific and workmanlike manner and reflects credit alike on



CURVES AT STREET INTERSECTION.

the ability of the engineers and the judgment of the officers of the road.

CONDITIONS FOR RURAL TROLLEY ROADS IN NEW JERSEY.

Mr. Edward Burroughs, the State Road Commissioner of New Jersey, has laid down certain rules which he regards as vital to protect the public interest. His main point is that the grants of right of way should require the track to conform to the width of vehicles generally in use on the highways; that the rails shall have at least four inches flange, and that wherever the tracks are laid upon public roads the space between the rails and for at least 15 inches outside of them shall be either paved or macadamized so as to secure a good roadbed.

THE BEECHER SINGLE RAILWAY SYSTEM AT WATERPORT, N. Y.

For some time past experiments have been carried on at Waterport, N. Y. with a system of railroad construction requiring but a single rail, the invention of Capt. Lina Beecher whose work in this and allied electrical branches dates back over ten years.

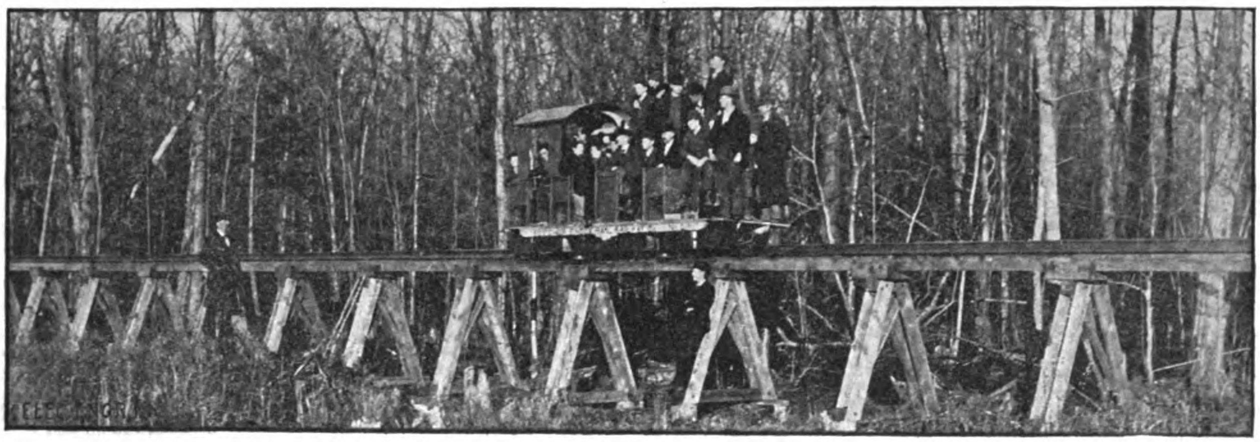
The Beecher system of road construction, consists of a track having a single T-rail with two guide rails 18 inches apart running horizontally beneath it. The car is provided with two wheels in the centre, bearing on the T-rail, with four guide wheels depending from the car frame running horizontally with bevel edges upon the guide rails; the use of these guide rails and wheels is to keep the car in an upright position when stationary or running at a slow rate of speed and to prevent the possibility of its leaving the track. This is further accomplished by the under flanges on the guide wheels. When the car is running at a speed of over ten miles an hour the car runs on the two centre wheels, only touching the guide rails occasionally with a swinging motion.

The equipment of the experimental car which has been operating at Waterport consists of fifty cells of Chloride accumulators and a five horse power slow speed series wound motor, together with controlling apparatus. The car complete weighs about four tons without passengers, and has a seating capacity for twenty-four persons. On a recent trial trip carrying a load of twenty-three people a speed of nineteen miles an hour was attained with an expenditure of only 3¾ horse-power, a most encouraging result. The electrical equipment was designed and installed by M. H. Johnson, of Utica, N. Y.

After a test in the recent blizzard during which the car operated perfectly on a track covered with snow and ice, a contract was given by the Waterport Electric Light & Power & Railroad Company for the construction and equipment of four miles of this road extending from Waterport to Lakeside in Orleans County, N. Y. Should this piece of track meet with the success anticipated, the line will be extended northeast to Oak-Orchard-On-The-Lake, and south through the important towns in the vicinity, through to Batavia, in Genesee County, in all a distance of about forty miles. The Equipment Construction Company of Batavia have received the contract for this work and will equip the line with cars to make a speed of about forty miles an hour including stops. Each motor will draw a train of two trailer cars.

The accompanying engraving shows the experimental car with a piece of the track built on trestle across a swamp. The ordinary structure will be upon single posts and will normally be 12½ feet above the surface, crossings at highways to be 15 feet and at railroads 18 feet high.

The road will be operated by waterpower from Oak Orchard River at Waterport where a dam forty feet high will be erected for that purpose.



The Beecher Single Railway System at Waterport, N. Y.

A GRADE CROSSING DECISION IN CONNECTICUT.

The Connecticut Supreme Court, by three judges to two, Chief-Judge Andrews and Judge Hamersley dissenting, has found for the Bridgeport Traction Company in the sharply contested and important case involving its right to cross the New Haven Railroad tracks at grade just south of the station in that city. The dispute led to a riot last summer. Judge S. E. Baldwin wrote the opinion which reversed the decision of the lower court. The Connecticut Railroad Commission has held in this and several analogous cases that they had under the electric-road charters the right merely to regulate, not to stop, grade crossings. The Supreme Court decision evidently sustains this view.

Gov. Coffin, of Connecticut, in his message to the Legislature of the State insists that the law should at once be changed so as to prevent the crossing of steam and electric lines at grade.

THE SUPPLEMENTARY WIRE FOR ELECTRIC RAILWAYS.

BY

H. S. Wynkoop

Scarcely nine months have passed since Mr. J. H. Vail read before the National Electric Light Association a paper on the Importance of Complete Metallic Circuits for Electric Railways, in which he conclusively proved the value of careful and heavy bonding, not only as a means of economizing at the coal pile, but also as a preventive, to a great extent, of electrolysis. Prior to that time, and during a period of ten years, not more than ten patents were issued on rail bonds (several of these being for devices to be employed in connection with automatic block signaling)—an average of one a year. Since then the patents issued on electric railway bonds exclusively have averaged one a month.

It seems rather singular that this sudden awakening to the importance of an improved track return has not led to the abandonment of the supplementary wire. Our calculations have shown that, in the great majority of cases, the total sectional area of the rails, reduced to equivalent circular mils of copper, is far in excess of the total circular milage of the outgoing circuit. Since the formulæ generally used assume the resistance of the ground return to be equal to that of the overhead line, it follows that, if we use bonds whose total cross section is equal to that of the overhead line, we introduce into our electrical determinations a factor of safety which in a measure counterbalances defective workmanship in the placing of the bonds. Why, then, should we stretch between the rails, and parallel to them, an additional bare copper wire, which within a few months will probably have disappered, leaving only a green streak in the earth to mark its grave?

There are two causes which have coöperated in keeping the supplementary wire before the public. One is force of precedent, arguing that, since the wires have been employed from the very beginning, they are still necessary—an argument having great weight with those engineers who *guess* at the amount of copper required for a given installation. The other, and a more aggressive one, is found in the fact that the additional wires do decrease the total resistance of the circuit, *as long as they last*.

In the beginning of single trolley construction, telegraph and telephone experience coupled with a few rules of physics, were our guides. It was therefore natural to assume that the earth's resistance was practically nil, and that an ordinary street car track of 20 lb. rails bolted together would furnish a very satisfactory path for the return current. Experience proved that the joints were worthless as electrical contacts, and a No. 4 B. & S. galvanized iron wire was adopted as a suitable path around the joints, the ends being passed into holes drilled in the rails, and then upset. This was the primitive bond. Subsequently it was reinforced by another, thus halving the resistance at the joint; and by cross bonds, or connections from one line of rails to the other, to insure continuity of the circuit in case one or more of the bonds should break.

The supplementary wire was a child of necessity, brought forth as the outcome of rivalry between the two pioneer railway companies. Both companies employed bonds of nearly the same efficiency; but one of them controlled the feeder-and main patent, then considered valid by them. The other company, in order to obtain competitive results, found itself obliged to place more copper in the circuit. Rather than advertise this fact by running overhead wires, resort was had to the following expedients: The substitution of a No. 0 B. & S. hard drawn copper trolley wire for the No. 4 silicon bronze, the substitution of a No. 0 B. & S. copper wire bond for the No. 4 galvanized iron, and the placing of a supplementary copper wire, connected at intervals to the bonds. It will be noted that this company could then boast of less copper overhead than was employed by the feeder-and-main people, and at the same time obtain fairly equivalent results (in economy, but not in evenness of pressure), the extra copper being placed where it could be covered up and forgotten, and—as subsequent events have shown—so acted upon by salts in the soil as to disappear entirely.

While the two systems of electric traction were elaborating, track construction developed. In place of the 20 lb. centre-bearing stringer rail appeared the girder and the tee, of 35, 40 and 45 lbs. per yard. It followed naturally that, with the advent of heavier cars, heavier motors and heavier rails, a heavier bond should come into service, and to meet the demand for heavier devices all round, the supplementary wire was increased in size. So much for precedent.

The feeder-and-main patent is dead; none can argue for the supplementary wire on the ground that it is rendered necessary by competition. There are no longer "systems" of overhead construction. This wire, so persistently employed in the past as to be considered desirable in the present, must stand or fall solely upon its merits as an economizer of fuel.

To begin with, let us assume that the supplementary wire is not acted upon by salts in the soil, that its total disappearance is not a mere question of time, and that this time is not often (as on parts of Atlantic Ave., Brooklyn) a mere matter of a few months.

Take a case which we can meet with any day: A 60 lb. girder rail, single track, two No. 0000 B. & S. copper bond wires per joint, two No. 0000 B. & S. supplementary wires twisted roughly together and soldered at frequent intervals to the bonds. The combined sectional area of the two rails is equivalent to 2,880,000 circular mils of copper, the total cross-section of four rail bonds is 846,400 circular mils, and that of the supplementary wires, 423,200 circular mils.

The resistance of this system, per thousand feet, assuming that all joints are electrically perfect, is .000369 ohm. In making that calculation I have assumed 900 ft. of rail and 100 ft. of bond in the thousand feet. If we take away the supplementary wires and employ a part of the copper thus saved to increase the bond capacity to that of the rail, we have reduced the resistance to .000364, a saving of .000005 ohm—an important matter when dealing with heavy currents. As we have taken up about 1,282 lbs. of copper, and have added to the bonds only 616 lbs., an actual saving of copper amounting to 666 lbs. per thousand feet has been effected, together with a decrease in the resistance of the return circuit.

ELECTRIC RAILWAY WORK IN WASHINGTON.

TACOMA, WASH.—The Point Defiance Street Railway in Tacoma has been sold by the Sheriff for $82,000. It was bid in by Judge Paxton of Portland, Ore., attorney for S. Z. Mitchell of the same city, who represents the General Electric Company. The sale was on a foreclosure of mortgage by Charles S. Hinchman of New-York.

A STANDARD GAUGE TROLLEY ROAD FOR CANADA.

A standard gauge railway for freight and passenger traffic, to be operated by electricity, is to be built from Oshawa, Ont., to the Grand Trunk Ry., and thence to a harbor on Lake Ontario. The road will be about seven miles in length, with branches to each of the factories in Oshawa. The plans for the road have been filed and it is to be in running order by June 15. Mr. M. J. Butler, of Desoronto, Ont., is chief engineer.

TROLLEY MAIL AND FREIGHT SERVICE FOR DES MOINES.

Under the new ordinance of the city council, the Des Moines City Railway Co. is allowed to haul mail and express upon the streets, and from time to time the city council is given the power to grant the privilege of hauling freight and other articles by the passage of a resolution. The term of the franchise is ten years, and the first of February of each year the railway company has to file with the city treasurer a report of its earnings by hauling mail, express, etc. This report is to be sworn to. For the first five years the company will have to pay to the city 3 per cent. of its gross earnings from the hauling of freight, mail, express, etc., and for the second five years 5 per cent. These payments to the city treasurer are to be made annually. Further than this the council reserves the right to regulate the operation of the company, and will designate the streets over which the mail, express, etc., will be hauled.

THE NEW YORK UNDERGORUND.

In his report to the Rapid Transit Commission Chief Engineer Parsons estimates that the proposed underground railroad for New York will cost $48,250,000, which is within $1,750,000 of the full sum that can be legally spent for the purpose. Ways will be found of spending the surplus million and three-quarters.

ELECTRICITY FOR THE NEW YORK ELEVATED.

Mr. Russell Sage says that while it is not true that the Manhattan Railway Company is about to sign a contract with the Westinghouse Electric Company for the equipment of its lines by electricity, he knew that Mr. George Westinghouse had given the matter a great deal of thought, and that he understood that he had nearly perfected a plan which would be offered to the company before very long. "I know I am not a young man," Mr. Sage said, "but I expect to live to see the elevated roads run by electricity; yes, and a double-deck road, too, with elevators to carry passengers up and down at the stations, run by the same power."

MISCELLANEOUS.

HOW DOES ELECTRICITY KILL?

BY

E. B. Rosa

In THE ELECTRICAL ENGINEER of Jan. 2, Mr. F. A. La Roche gives some interesting experiences and experiments bearing upon the above subject. Having got into an arc light circuit of about 2,000 volts, he infers that two amperes of current flowed through his body from hand to hand, because the resistance of the lamps (when *receiving their normal current*) was about 200 ohms and the resistance of his body was 800 ohms. How this last quantity was determined he does not tell us. That the resistance of the body varies greatly according to the kind of contact is well known, and the following measurements made upon myself illustrate the fact. The first seven were made with a storage battery and a Weston voltmeter.

	Resistance.
1. Fingers dry, copper wires grasped tightly between thumb and fore finger	57,000 ohms.
2. Fingers moistened, copper wires grasped tightly between thumb and fore finger	19,000 "
3. Fingers partially dried, copper wires grasped tightly between thumb and fore finger	30,000 "
4. Fingers wet, copper wires grasped tightly between thumb and fore finger	12,600 "

Two brass tubes ¾ in. in diameter and 4 in. long, to which were soldered copper connecting wires, were used as handles, and the storage battery joined as before in series with the voltmeter and the body.

	Resistance.
5. Hands slightly moist, grasping the tubes tightly	5,000 ohms.
6. Hands wet, " " " "	2,700 "
7. Hands wet with salammoniac solution, grasping the tubes tightly.	1,570 "

Next an alternating current was used; the voltmeter was replaced by a delicate dynamometer, and each time a non-inductive resistance of such value as to give the same deflection, was substituted for the body. This gave at once the resistance of the body.

		Resistance.
8. Fingers grasping copper wires	at 50 volts,	10,000 ohms.
9. Hands moist and grasping brass tubes	" 19 "	2,000 "
10. Hands wet " " " "	" 19 "	1,750 "
11. Hands in water " " "	" 11 "	1,500 "
12. Hands wet with solution of salammoniac and grasping brass tubes	at 11 volts,	1,100 "

Thus the resistance of my body, from hand to hand, varies from 57,000 with dry fingers grasping fine copper wires to 1,570 with wet hands grasping brass tubes, or hands immersed in water containing salammoniac. And for alternating currents, with probably better contacts, it was as low as 1,100 ohms.

In the latter case 11 volts gave as strong a current as I cared to take, and that was only $\frac{1}{100}$ of an ampere. The shock was greater than when one carelessly takes the terminals of a 200 volt alternating circuit in his fingers.

Now what kind of an accidental contact can one make in order that his resistance from hand to hand may be as low as 800 ohms? It seems to me it is more likely to be 8,000 ohms. I myself once unhappily got into the circuit of a 20 light arc dynamo, and for

some seconds was held fast, being utterly unable to loosen my grip. The sensation was certainly terrible, and the powerful shock to the nervous system was felt during the remainder of the day. But I have no idea that an ampere, or even a quarter of an ampere passed through me. Nor could I have determined this from the voltage of the machine, for everything depends upon the contact which is always uncertain; but it could not have been any better than with moist hands grasping large brass tubes, and that is about 5,000 ohms.

Experiments upon cats, dogs or men in which the voltage only is recorded are worth almost nothing, and are indeed misleading. For we cannot determine the strength of the current without knowing the resistance as well, and it is the *current* that affects the body, not the voltage. For example, here is an astonishing experiment in which a cat survives the shock of a current at 1,000 volts. But we haven't the slightest idea what the current was. If contacts were poor, perhaps 900 volts were spent in overcoming the resistance at the contacts, and 100 was spent upon the tissues of her body. If so, then it is not so remarkable. If an ammeter had been inserted and we were told what the current was, then it would have been interesting.

I have measured the resistance of a large cat with a low voltage alternating current. The hind feet were held firmly in contact with the bottom of a tin cup containing a small quantity of solution of salt and the fore feet were placed similarly in a second cup. The resistance was 4,000 ohms, using an electromotive force of 11 volts. Then deep cups were used and the legs plunged three inches into the solution; the resistance was 1,900 ohms. The current was little more than two-hundredths of an ampere and yet it was much more than the cat relished. If the cat had merely stood with wet feet upon metal plates her resistance might have been as much as 8,000 ohms, and a thousand volt current would have been no greater than a current from a circuit of 240 volts with legs immersed in salt water. This simply illustrates how important it is in all such experiments to measure and report the current, as well as the voltage.

Again, Mr. La Roche says that frequently he "has had 450,000 volts pass through his body, this quantity being, however, only the fractional part of an ampere." Of course he did not mean that 450,000 *volts passed through his body;* volts don't pass through any body! What he meant was that he had sustained the shock of a current whose electromotive force was 450,000 volts, and that seems a terrible circuit with which to come into contact. But the 450,000 volts was certainly not all expended upon his body, as the statement implies. And if there was a long spark through the air to his body, and the current then flowed through a badly conducting path to the earth, probably only a small fraction of the total voltage was spent upon the body.

Every one who saw Prof. Elihu Thomson at the World's Fair receive long sparks from his high potential transformer through a metal ring held tightly in his hands was amazed at his daring, and wondered that the effect was not more serious. But he prudently stood on a stool, high and dry, and the resistance through the air and to earth through the stool was enormously more than that of his body; hence the voltage spent upon his body was not nearly so great as it appeared.

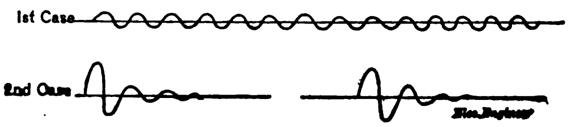
In these cases of high potential discharges it is hard to estimate what the current is which passes through the body. If it were an alternating current of ordinary frequency, we could estimate the current from the voltage and energy expended to produce it. But the primary is the discharge current of a Leyden jar, with an exceedingly high rate of alternation, and then there is a period of rest and another series of discharges. Hence if the average current in such a high voltage circuit is only a hundredth of an ampere, the actual currents flowing may have maximum values many times as great.

A Leyden jar discharge through the body produces a powerful shock. We know that the quantity of electricity in the jar is excessively small, and we perhaps think that the shock is due to the high potential, and not to the quantity of the current. But how can a high potential hurt us? It is rather due to the *large current*, for if a Leyden jar containing a moderate quantity of electricity discharges in a hundred-thousandth or a millionth of a second the current might be as great as ten or even a hundred amperes, and under some circumstances it would flow back and forth many times before the oscillatory discharge is complete.

So also in the case of lightning. The discharge is so sudden that a very small total quantity of electricity gives a very large current, which surges back and forth many times before the discharge is complete. Evidently it is not the total quantity of electricity which does the damage, but the large current, which in this case flows for a very short interval of time.

Now in the case of very high potential discharges we may distinguish two cases. First, such as those Tesla produces with a high frequency alternator. Second, such as Thomson produces with an interrupted Leyden jar discharge for a primary circuit passing through a few turns of coarse wire for a primary coil, and a larger number of turns of wire for a secondary, the whole being in oil. In the first case we have a regular alternating current of very high frequency; in the second, an interrupted series of alternating discharges. If the Leyden jars or other condenser in the primary circuit is charged with an alternating current of 100 complete periods per second, then 200 times per second the oscillatory discharge occurs through the spark gap, and at each such discharge there is a short series of (alternating) discharges in the secondary, of very short period; then there is an interval of rest, and a second such series, and so on.

Suppose that in a Tesla combination of dynamo and transformers, the period is 10,000 per second, the electromotive force is 100,000 volts, and the energy of this secondary current is a kilowatt; then the average current is $\frac{1}{100}$ ampere, and the maximum current only about 50 per cent. greater. Next suppose we have a Thomson high potential transformer with a period of 100 per second in the primary, but the oscillating discharges of the condenser 10,000 per second. Suppose the voltage is 100,000 as in the other, and the energy, and therefore the heating effect along the path of discharge, is also the same. See illustration.



Since the current in the second case is interrupted, flowing for a short interval every two-hundredth of a second, the maximum value of the current must be much greater than in the first case.

And if we suppose that the physiological effect is due to the maximum value of the current, as seems probable, then it is clear that in the case supposed the effect would be much less in the case of the Tesla current than in the case of the Thomson, as is found to be the case. In both cases, however, the effect is vastly less than when a Leyden jar is discharged through the body, for the current is relatively very small, the major part of the potential being spent upon the air, and only a remnant is spent on the body. If we suppose the resistance of the body to be as high as 10,000 ohms, (its impedance would not be sensibly higher, even for a frequency as high as 10,000 per second) then, when the current is $\frac{1}{100}$ ampere, as we supposed, there would be spent upon the body only 100 volts of the 100,000, the remaining 99,900 being spent on the air.

WESLEYAN UNIVERSITY.

UNDERGROUND AND OTHER WIRES IN BROOKLYN.

Professor George W. Plympton, president of the electrical subway commission has presented the following summary:—Total length of electrical conductors of all kinds within the old city limits at present time is 15,840 miles, of which amount there is in conduits either underground or suspended to elevated roads a total length of 9,880 miles; on poles and housetops, 6,460 miles; amount buried during the year, 1,960 miles; of the above total of aerial systems (6,460 miles), about 870 miles belong to the fire and police departments and are beyond the jurisdiction of this board.

A notable event of the year was the beginning of the construction of conduits for the high tension conductors which furnish arc lights for the streets. No wires of these systems are yet buried, but a good beginning of underground construction has been made. The aggregate length of single duct constructed by the two arc light companies is about twenty-two miles. Wires will be drawn into the ducts during the winter and the construction of the conduits continued in the spring.

Some three hundred miles of telephone wire were rendered useless last year by reason of the corrosion of the lead covering of the cable.

EFFECT OF THE ELECTRIC ARC ON CARBON.

In the course of the series of experiments undertaken with the electric furnace during the past two years, M. Henry Moissan has had occasion to deal with the vaporization of carbon. After having detailed his investigations before the French Academy of Sciences, he concludes as follows: (1) That in vacuum, as in ordinary pressure, carbon passes from the solid to a gaseous state without assuming a liquid form, and from this point of view it may be compared to arsenic; and (2) when gaseous carbon reassumes a solid form it always furnishes graphite. M. Moissan estimates, however, that carbon can be brought to a liquid state, but this phenomenon would only be produced under the action of more or less strong pressures. In the case of high pressures, as his previous experiments established, the density of the carbon would increase and the diamond would be obtained. In fact, he has been able to prepare small diamonds. Both at the Cape and in Brazil diamonds are found which possess no trace of apparent crystallization, and which have rounded forms such as can be taken by a fluid maintained in the centre of a "milky" mass. Carbon under pressure could then take up the liquid state and be solidified as water, either by presenting a confused mass of crystals or by taking a rounded and amorphous form.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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CONTENTS.

PUTTING THE STEAM LOCOMOTIVE ON THE SHELF.

IN discussion of the necessity that has arisen for the steam railroad companies to meet the competition of the trolley roads, we have ventured to express the belief that a remedy would lie in the adoption of electricity by the roads that have hitherto depended upon the steam locomotive. Deprecating the attempts made by some steam railroad companies to kill or choke off the new competition, which in most instances thus far has been based upon a desire to make profit out of new public service rather than by cut-throat paralleling, we have suggested that nothing would be easier than for the old companies to equip parts of their systems tentatively and thus gradually put themselves in line with the new conditions which are absolutely sure of prevalence sooner or later. The electrical tendency is now so clear and strong everywhere—and has so positively won the day in cities,—that our advice need not be looked upon as that of a special pleader interested only on one side; and we are glad to note that the New York, New Haven & Hartford Railroad Company, one of the oldest and best roads in the country, representing brains and wealth to a striking extent, has now decided to equip at least two. of its branch lines electrically.

It will be admitted that no leading railroad makes such changes as this lightly or easily and when the new departure involves putting the old steam locomotive on the shelf, it will be further admitted that an important advance has been made toward the final operation of all roads electrically, either by machinery already familiar to the electrician or by apparatus so novel in form and in principle that it in turn cannot supersede its predecessor without years of practical evolution. The two branches of the New York & New Haven to be equipped first with the trolley system are its Nantasket Beach line and its Warren & Bristol line; but we find the following significant language put into the mouth of Vice-President John M. Hall: "He was not prepared to say how far the New Haven road would use the electrical system in other localities, but the four track system between New Haven and New York, as a matter of fact was in such a condition and so built as to permit the use of concentrated energy in the form of electricity whenever it had been demonstrated that a change of this magnitude was warranted in an economic sense."

One of these branches, the Nantasket, thus operated will be about 10 miles in length; the other will have a length of 35 miles, and its circuits will be fed into by two power houses. Such propositions are regarded by any electrical engineer as "dead easy," although we note some of the old steam railroad men who don't read much talking of the work as "experimental." What is really experimental with electricians is the attempt to cross country with lines lighter than those of either the steam or the trolley service. We illustrate one such interesting experiment this week in the Beecher system on trial at Waterport, N. Y., where an elevated track is used with only one running rail. Just what the final evolution in this direction is to be we do not undertake to say, but an opinion may be offered that such roads have a distinct place and value in the

rural economy. England is at the present moment quite agitated on the subject, and the Central Chamber of Agriculture has sent a circular of inquiry to all its associated chambers and clubs throughout the kingdom asking them to express their views as to the provision of light railways in their respective districts. They are specially asked to consider whether light railways would be advantageous, and if so, for what class of traffic they would be used; what is the greatest distance of a farm from a railway station; to what extent a light railway would enable farmers to keep less horses; to and from what points it should, if constructed, run; what description of light railway would be best; and whether the ordinary gauge or a narrow gauge would be preferable. Evidently this inquiry can but produce proof of the further possibilities of electrical railway development as successfully for light lines as for the heavy ones on which electricity is now being adopted to the exclusion of steam.

AIR CIRCULATION CABLES AND INSULATION.

CABLES and cable insulation continue to absorb the attention of electrical engineers and during recent years the close observer can not fail to have remarked the changes and improvements which have been introduced. These changes have perhaps been most notable in the construction of telephone cables and may be said to date from the time that Mr. W. R. Patterson brought out his fibre-insulated lead covered cable for telephonic purposes. Even our own telephone engineers viewed this innovation with suspicion and were slow in adopting it, but after more than ten years of actual use that type of cable may fairly be said to be the standard in the United States for underground telephonic distribution. It would be interesting to dwell on the continued efforts of manufacturers to reduce the electrostatic capacity, which have resulted in bringing this disturbing element down to less than $\frac{8}{100}$ microfarad per mile, and how the insulation between wire and wire has been gradually reduced to a mere loose layer of paper but we must forego this pleasant task. American success would have seemed sufficient to induce our foreign cousins to try the lead covered paper cable long since, but they have no doubt been afraid of it, and indeed they still appear to be afraid to let themselves out on it if we may judge of recent work, such as that now being carried out in Paris, which we describe on another page. While satisfied with the low electrostatic properties of the paper cable, they still seem to be fearful lest the insulation will give out in some unaccountable way, even should the lead envelope remain intact. The results obtained by the circulation of dry air through the cables must be admitted to show most excellent results, but we must confess that we fail to see the great necessity for the application of this method, especially in view of the experience had with cables of the same type in this country. Such cables have been in use for years laid in conduits in our streets and have entailed surprisingly small expense for repairs, while the insulation has practically remained unchanged where the lead envelope has been kept intact. Indeed it would surprise many of our readers here, as well as our foreign friends, to know that lead covered paper cables have been laid across rivers. One is now actually in operation, and has been for some time, across the Hudson River at New York. The laying of such a cable in such a place might a few years ago have been considered little short of suicidal, but experience has demonstrated the perfect practicability of the scheme. In considering the laying of such cables in such situations the fact must not be lost sight of that a 100-pair, paper insulated, lead covered cable can be bought for fifty cents a foot, while the rubber insulated cable would probably cost not less than three dollars per foot; while, figured on the basis of equal $K\ R$ the price would be fifty or a hundred to one in favor of the paper cable—other considerations left out. It will thus be seen that even if it be admitted that the paper cable is risky under water, its cheapness is such that one can afford apparently to throw it away when it has developed serious defects and to put in a new one. We are indeed glad to note that the fibrous cable is at last obtaining recognition abroad and expect to see a large extension of its use there when its merits are fully understood for this special class of work.

POWER DRIVEN VEHICLES.

THE prize contest instituted between various types of power driven vehicles which took place last year over the highroads between Paris and Rouen has served to stimulate the manufacturers of this class of apparatus to the highest degree, and at the present moment a considerable section of the Cycle Exhibition at the Palais de l'Industrie in Paris is given over to the exhibition of self propelling carriages. We also note that a new prize contest is to be instituted for carriages without horses covering the road between Paris and Bordeaux. Electricity, steam or any other mechanical power will be allowed, and competitors of all nations will be permitted to enter the tests. Mr. Marcel Deprez, the well known electrician, is a member of the Committee of Organization. The winner will receive one half the total subscriptions which already amount to 46,000 francs. There ought to be a good chance for the electric carriage and probably several of them will be entered. Unfortunately the contest will have little more than an academic interest for Americans, owing to the fact that but a small percentage of our country roads are of such a nature as to permit of the employment of self propelling vehicles. The cycling clubs throughout the country have done much to improve existing roads but when we contemplate the rapid increase of the country electric roads offering cheap transportation for passengers and freight, we are afraid our cycling friends have a hard time before them. We are strengthened in this view of the situation by the remarkable report of the Road Improvement Committee of the Ohio State Legislature, which strongly advocated a "masterly inactivity," on the part of the State in extending aid towards road improvement, owing principally to the cheapness with which electric roads could be built and operated, utilizing the present high roads.

CURRENT REGULATION—IMPORTANT DECISION.

As we go to press word comes that the United States Circuit Court, at Chicago, has dismissed the bill of Thomson-Houston Electric Co. vs. Western Electric Co. The suit, of long standing, was based upon the patent of Thomson and Houston on the automatic regulation of arc light machines.

JAMES U. MAC KENZIE.

By W. J. Hammer.

James U. Mac Kenzie.

The many friends of Mr. James U. Mac Kenzie will regret to learn of his recent death from paralysis of the brain and heart failure. Mr. Mac Kenzie was born in Inverness, Scotland, on the 12th of March, 1837, removing with his family to America at the age of nine years. The early portion of his life was spent at Niagara Falls. He was connected for eighteen years with the Grand Trunk Railway, and it was during this period that he made the acquaintance of Mr. Thomas A. Edison, who has been his life long friend. During the time Mr. Mac Kenzie was stationed at Mt. Clemens, Michigan, where he occupied the position of station master and telegraph operator, Edison, who was at that time a mere boy, engaged in selling papers and fruit on the cars, saved at the risk of his life, Mr. Mac Kenzie's eldest child, James B. Mac Kenzie, three years of age, from being run over by a train; and out of gratitude for this service, Mr. Mac Kenzie taught young Edison how to telegraph. Edison soon became so proficient that he was at times allowed to send dispatches from the station, and this experience resulted in his taking up telegraphy as his means of livelihood, becoming, as is well known, one of the most expert operators in the United States. From that time, as already stated, there always existed a warm friendship between Mr. Mac Kenzie and Mr. Edison. Referring to the death of Mr. Mac Kenzie, Mr. Edison wrote to the writer a few days ago as follows:—"I was very sorry to hear of the death of my old friend Mr. J. U. Mac Kenzie; he was a kindly, honest man and a good friend."

Mr. Mac Kenzie organized the American District Telegraph Company of Detroit, of which he was Secretary and General Manager, being ably seconded in his efforts by his step daughter, Miss Rebecca P. Campbell now Mrs. John R. Wood of Brooklyn, she being well experienced in the district telegraph business. His success with the American District Company in Detroit led to his being called to take charge of the Washington, D. C., Company then in a demoralized condition. He succeeded in putting it upon its feet and remained in charge until the Company was absorbed by the Bell Telephone Company of that City. He also organized the Bell Telephone Company of Detroit and constructed there one of the first exchanges put in operation in the United States. In 1875 he endeavored to organize the Edison Electric Light Company of Detroit, his efforts, however, meeting with but partial success. The work was subsequently taken up by others, resulting in the organization of an important Edison Company in that City.

He also visited Canada in the interests of the Edison incandescent electric light and endeavored to organize a company in Toronto, with the co-operation, among others, of his uncle, Sir David Mc Pherson, Senator and at one time Speaker of the Canadian House of Parliament. After leaving Detroit he came to New York, entering the service of the American District Telegraph Company, and subsequently he entered the employ of the Union Fire Alarm Telegraph Company of New York. He made the original installations of police patrol system in the cities of Brooklyn, N. Y., Hartford, Conn., Baltimore, Md., and Philadelphia, Pa. He also obtained contracts and established the fire alarm and telephone systems in Middletown, N. Y., Yonkers, N. J., Hoboken, N. J., Orange and East Orange, N. J., Scranton, Pa., Bradford, Pa., Erie, Pa., La Crosse and Appleton, Wis., and and Zanesville, Ohio. He was connected for some eight years with the Gamewell Fire Alarm and Telegraph Company of New York.

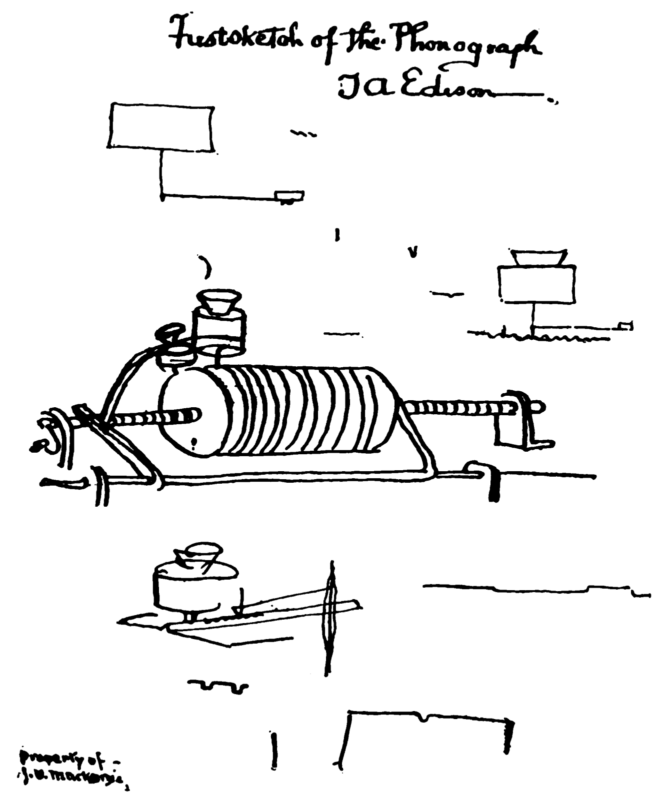
Mr. Mac Kenzie took out quite a number of patents on inventions of his own, connected with telegraphy, fire alarms, etc., among these being the Mac Kenzie and Pond indicator which he exhibited at the Paris Electrical Exhibition in 1881; the Mac Kenzie universal transmitter; visual indicator, etc. His ingenuity was evidenced also by a number of very successful puzzles which he brought to public notice, the best known of which is the 'A. B. C. Puzzle."

Mr. Mac Kenzie's friends and acquaintances will remember him as a hale and hearty man, standing over six feet in height and weighing over two hundred pounds; few of them however know the following story about him which is vouched for by his family; and he has told the writer that it was a matter of record in the annals of surgery. When quite a young man he had the misfortune to break one of his legs, rendering him quite lame as in the setting the fractured limb shortened 1¾ inches. Some four years later while crossing the Hudson River one winter's day he was thrown from a stage coach during a collision and dragged some distance. This resulted in breaking the other leg in eight places. He was placed under the care of Dr. Swinburne at a hospital at Albany, and in healing the limb contracted sufficiently to match the length of the one previously broken. He then walked again as well as any one. It is said that but for these accidents his height would have been 6 ft. 4¾ inches.

Mr. MacKenzie spent considerable time at Edison's Laboratory during the early days of Edison's work in connection with the phonograph, telephone, and the incandescent light. It will not be out of place to introduce into this article a sketch which Mr. MacKenzie treasured most highly, and which he received from Mr. Edison at the time of the birth of the phonograph. The writer well remembers Mr. MacKenzie's telling the circumstances under which this sketch was made. While at Mr. Edison's house, at Menlo Park, N. J., one evening, he said, Mr. Edison took a sheet of paper and drawing a sketch thereon handed it to him with the remark, "Mac, do you know what that is?" "I do not," he replied, "but it looks like a machine for filling sausages." "That," Mr. Edison replied, "is a machine that will talk." Mr. MacKenzie asked him if he might keep the sketch and was told by him that he might, and it has ever since been in his possession. Not long ago Mr. MacKenzie showed it to Mr. Edison and asked almost the identical question which had been put to him many years before, and Mr. Edison who had never seen the drawing in the interim exclaimed with great interest, "Why Mac, that is the first sketch ever made of the phonograph." It is stated that Mr. Edison made a subsequent sketch which he took to the Laboratory and wagered with one of his assistants that when the machine was made, it would talk, and talk it did.

Mr. MacKenzie was also for a time connected with the parties exploiting the Edison Kinetoscope.

He was first married at the age of 20 to Miss Sarah Benner, daughter of a Methodist clergyman. They lived together ten years, when his wife died, leaving him with two sons, James B.,



Edison's First Sketch of the Phonograph.

of Washington, and Alexander, of Brooklyn. He subsequently married Mrs. Elizabeth Campbell, née McGregor of Detroit, Mich., who also had two children, a son and daughter, Rebecca P. and John R., and to this family of four, were added another son Frank B. and a daughter Naomi F., all of whom survive him.

TRANSMITTING, RECORDING AND SEEING PICTURES BY ELECTRICITY.

BY

Geo. R. Carey.

In 1873 I first became interested in that property of selenium by which it changes its electrical conductivity when exposed to light varying in intensity. In 1876 the idea occurred to me that this property of selenium might be utilized for transmitting the image of any scene or object to a distance, and there, by other means, leaving a permanent record, or otherwise, of the same; and in 1877 I invented the following instruments to accomplish these results.

The transmitter shown in Plate I, Fig. 1, is a modified camera grounded at E. In the focus of the lens is placed an insulating disc, P, which is perforated with numerous small holes; each hole being partly filled with selenium, that completes the circuit between the ends of the wires A and B, Figs. 1, 4 and 5.

The wires B are insulated and are wound into a cable which connects with the receiving instrument, Fig. 2, at the other end. There the wires are separated and passed through the insulating disc, C, in which they are arranged relatively the same as in the disc P, Fig. 1. The ends of the wires from the cable, B, press against a chemically prepared paper which is placed between the insulating disc, C, and the metallic disc, D, Fig. 2, the disc, D, being grounded at E.

Fig. 3, shows a sectional view in part, of Fig. 2. Fig. 4 shows a front view of disc P, Fig. 1; and Fig. 5, is a sectional view in part of disc P, Fig. 1, showing selenium points and conducting wires, A and B.

The operation of the apparatus is as follows: When the transmitter and receiver are in circuit with each other, and the image of any object is projected by the camera lens upon the selenium points and conducting wires A and B, in the disc P, Figs. 1, 4 and 5, the current will pass through each wire and selenium point in exact proportion to the intensity of the light in that particular part of the image, and the ends of the wires from the cable, B, being insulated and arranged in the same relative position in the

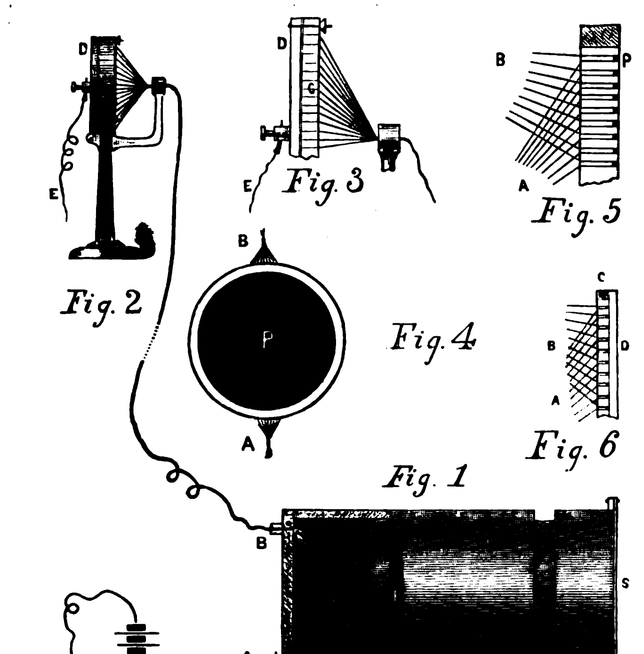


Plate I.

disc, C, Fig. 2, as in the disc, P, Fig. 1, the current will pass through the chemically prepared paper between C and D, Fig. 2, and print upon it a copy of the image projected upon the disc, P, of the transmitter, Fig. 1.

Fig. 6, shows a sectional view, in part, of another receiving instrument with platinum or carbon points covered with a glass cap, there being a vacuum between glass cap, D, and insulating disc, C. These platinum or carbon points are to be in circuit with, and arranged in the same relative position as the selenium points in the disc, P, Figs. 1, 4 and 5. Then, on the passage of the current, they become more or less incandescent in exact proportion to the intensity of the light affecting each selenium point, and thus give a luminous image at the receiver corresponding to the image of the object at the transmitter, Fig. 1.

The transmitter shown in Fig. 1, Plate II, is a modified camera grounded at E. In the focus of its lens, is a thin glass

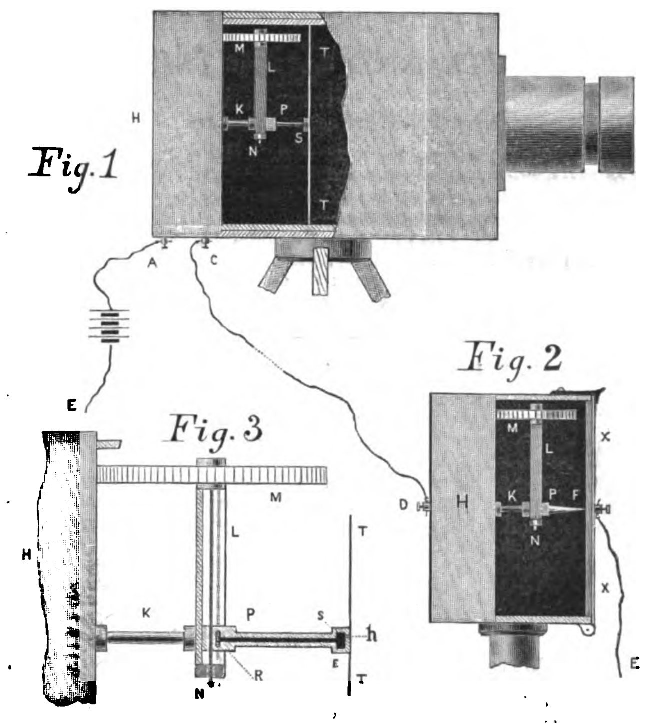


Plate II.

plate, T T, upon which is projected the image of the object to be transmitted. Behind the plate, T T, a selenium point, disc or ring, S, which forms part of the circuit, is caused to move in a spiral line over every part of the image projected upon the plate, T T, from centre to circumference by means of the following mechanism.

The clock-work in the case, H, Figs. 1, 2 and 3 revolves the shaft, K, causing the arm, L, and wheel, M, to describe the circle of revolution. The wheel, M, at the same time rotates on its axis by means of a circular rack on the front of the case H. The screw, N, being fastened firmly to wheel, M, turns with it, and is also threaded through the sliding piece, P, which is thereby moved in a spiral line over the plate, T T, Fig. 1, carrying with it the selenium point, disc or ring, S.

I prefer to use in the transmitter, instead of the selenium point, a selenium disc or ring, S, Figs. 1 and 3 enclosed in a case, E, that has a small hole *h* in its face near the circumference for the light to enter. This disc or ring, S, is caused to revolve by means of a shaft and pinion, R, which are driven by a rack on arm L, so that, as the piece, P, is moved towards the wheel, M, by the screw, N, a fresh surface of selenium is exposed continuously to the light. By these means the selenium that has been exposed to the light has time to recover its normal resistance after exposure.

The receiver shown in Fig. 2 is in circuit with the transmitter at any distance by only *one* line wire, C. D, and is constructed and operates the same as the transmitter, except that it has a metallic point F, in the circuit, that bears against a chemically prepared paper upon which the transmitted image is to be printed, this paper being fastened to the inner face of the metallic plate X X, which is grounded at E.

Fig. 3 is an enlarged view, partly in section, of clock-work and mechanism shown in Figs. 1 and 2.

Now it can be seen, that as the selenium point, disc or ring, S, Figs. 1 and 3, forms part of the circuit and traverses spirally the lights and shades of the image projected upon the plate T T, by the camera lens, the intensity of the current passing through it will correspond to the variations of light and shade as they affect the constantly moving selenium; and the receiving instrument, Fig. 3, being in circuit with the transmitter by only *one* line wire, C D, the metallic point F, moving spirally and in exact accordance with the selenium point, disc or ring, S, will pass over the surface of the chemically prepared paper and print upon it a picture corresponding to the image at the transmitter.

There may be used in the receiver Fig. 2 instead of the metal-

lic point, F, a platinum F, or carbon point in a vacuum. On the passage of the current, this point will become more or less incandescent, and owing to the persistence of vision, will give a luminous image of the transmitted scene or object.

I think these instruments will transmit and record images without using any external supply of electricity, since the selenium when exposed to light, becomes in itself a generator of the electric current.

SOCIETY AND CLUB NOTES.

MONTREAL ELECTRIC CLUB.

At the annual meeting held on Jan. 7 the reports for the past year of the secretary and treasurer showed the Club to be in an excellent condition, there being a considerable balance in the treasury and a large list of members.

The election of officers for the ensuing year resulted as follows: President, W. B. Shaw; vice-president, H. O. Edwards; secretary-treasurer, Cecil Dautre; committee of management, T. F. Pickett, W. Graham, J. A. Duglass.

N. E. L. A.—HOTEL ACCOMMODATION.

The indications are that the attendance at the Cleveland meeting will be very large, and several of the delegates intend taking their wives. Hotel accommodations should be reserved early to insure comfortable quarters. The headquarters will be at the Hollenden Hotel, the rates being: American plan, $3 to $5 per day; European plan, $1 to $3 per day. Other hotels in close proximity to the Hollenden are: The Weddell, $3 to $5 per day; The Stillman, $3 to $5 per day; Forest City, $2 to $3 per day; Kennard, $2 to $3 per day; American, $2 to $3 per day.

BUFFALO ELECTRICAL SOCIETY.

The Buffalo Electrical Society has secured the services of Prof. Albert L. Arey, for a course of ten lectures on "Practical Electrical Engineering" to be given at the rooms of the Society, in the Library Building; commencing January 19, and continuing every alternate Saturday evening, until the course is completed. Prof. Arey is a member of the New York University Extension Course, Professor of Physics in the Rochester Free Acacemy, and is eminently qualified to place before an audience, complicated problems in the most elementary manner. The course of lectures will be of a practical nature, particularly suited to those who have a knowledge of the rudimentary principles of electricity. Prof. Arey has a very complete outfit of experimental apparatus, and his demonstrations will be especially interesting and instructive.

LEGAL NOTES.

THE TELEPHONE PATENT SITUATION.

Our esteemed contemporary, *The Electrical World*, in its issue of January 12, continues to make matters worse by offering, in the way of an apology for its oversight of the Carty bridging bell patent, the plea that it doesn't amount to much any way. *The Electrical World* apparently takes the ground that the Carty patent is limited to organizations of circuits known as "party lines," for the reason that the device is particularly adapted to such service and because Mr. Carty in his specifications states that the object of his invention is, in a multiple station circuit, to arrange the apparatus in parallel. Our contemporary proceeds with painful elaboration to air its misapprehension of the function, scope and probable validity of patent claims in general.

While Mr. Carty's original intention and main object may have been to use his invention in connection with party lines, the fact is that there are to-day thousands upon thousands of Bell telephones involving this invention (including the one in the office of *The Electrical World*) which are used in connection with individual lines extending from a subscriber's instrument to a central exchange, and as the phraseology of some of Mr. Carty's claims is sufficiently broad to cover the organization at a single station without reference to other stations, we feel confident that no manufacturer could safely undertake to arrange his circuits in the manner described in the patent. Again unless there are at least two instruments connected to line during an actual conversation, the quantity and quality of the talk on the receiving end is not of the best and the telephone as a means of communication is likely to fall short of its true function of usefulness.

We believe that what the electrical public appreciates in the way of information on the telephone patent situation is not so much what THE ELECTRICAL ENGINEER or *The Electrical World* may think as to the scope or validity of any patent or patents, but what the patent *actually claims*. What the new telephone companies and telephone inventors appreciate at this time is to have pointed out to them what patents are in existence and *what the claims say*; they will then under the advice of their own counsel determine whether their proposed apparatus is in the line of fire or not. What the average new telephone manufacturing company wishes most to know with reference to any given patent is not, "Will we be hurt?" but "Will we be hit?" The desire of these new companies which are now springing up all over the United States is to avoid litigation rather than to invite litigation, even though they might prevail.

Touching another question — that of detail patents upon automatic telephone supports, there is one patent of considerable scope which, judging from recent activity on the part of inventors, has been overlooked; this is the patent of Mr. S. Bergmann of December 28, 1880, No. 235,988, the first claim of which is as follows:

1. The combination of a telephone-instrument, a support for said instrument when it is not in use, means which preclude the placing of the instrument on the support or its removal from the support without a movement of the support by the hand, and a switch which is operated simultaneously with the movement of said support to connect the instrument with or disconnect it from the electric circuit or line with which it is used, substantially as specified.

APPEAL BY THE AMERICAN BELL TELEPHONE CO. AGAINST THE CARPENTER DECISION.

The American Bell Telephone Company has appealed to the United States Circuit Court of Appeals against the decision of Judge Carpenter of the United States Circuit Court declaring the Berliner patent, No. 463,589, void. Among the errors assigned to the rulings of Judge Carpenter are that the court should have dismissed the bill in equity which was brought by the United States; that the court should have found that the Berliner patent was for a different invention from any that had been patented; that the court should have found that the Bell Company always intended and always did prosecute its application for the patent in suit with diligence and with intent and purpose to secure the issue of the patent at the earliest practicable day.

OBITUARY.

KIYOSHI SAWAI.

MR. C. SAWAI, of Tokyo, Japan, apprises us of the death, November 28th of his son Mr. Kiyoshi Sawai, Electrical Engineer. Young Mr. Sawai visited America some seven years ago, spending more than a year in a number of electrical factories, familiarizing himself with electrical industry in the United States. Returning to his native country he made good use of his acquisitions and took a conspicuous part in the development of the telephone service in Tokyo. All those who had the pleasure of meeting Mr. Sawai during his sojourn in America will pleasantly remember his bright presence and genial manners, and will deeply regret his untimley death.

PERSONAL.

MR. R. E. CROMPTON, has been elected president of the London Institution of Electrical Engineers.

MR. W. M. POTTER, has been elected secretary of the Philipsburg, Pa., Elec. Light, Gas, Power & Heating Co.

PROF. KOHLRAUSCH has been appointed head of the Physical-Technical Government Institute at Charlottenburg, in succession to the late Professor von Helmholtz.

MR. E. R. DODGE, for the past six years superintendent of the Charlotte N. C. Electric Light Co. is now stationed at Raleigh, N. C., where he has gone to establish an alternating lighting plant in connection with the street railway plant of the Raleigh Electric Co. He may now be addressed at the latter place.

MR. H. WARD LEONARD is in New York again after a long European trip on combined pleasure and business. One of his objects was to study the interesting Heilmann locomotive in which what is practically his method of motor control has been adopted.

MR. SAMUEL INSULL, president of the Chicago Edison Co., has just returned from a month's trip to Europe, spent chiefly in a close inspection of the latest central station practice in England, France and Germany. Mr. Insull rested a few days in New York en route for Chicago.

MR. HERBERT LAWS WEBB returned to New York last week from a six months' professional journey through England, France, Germany, Sweden and Norway, Switzerland, Germany and Austria, in each of which countries, it is understood, he made an expert study of the ways of doing telephonic work. Mr. Webb is on the engineering staff of the Metropolitan Telephone Co. of this city, by whom he was sent abroad on this important mission.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JAN. 8, 1895.

Accumulators:—

Storage Battery, T. A. Willard, Norwalk, Ohio, 532,128. Filed Jan. 5, 1894.
The plate is surrounded by a corrugated non-conducting sheath having horizontal slits for the circulation of the electrolyte.

Alarms and Signals:—

Electric Burglar Alarm, H. M. Scholes and G. M. Mayers, Kansas City, Mo., 532,291. Filed Apl. 17, 1894.
A testing system for burglar alarms.

Conductors, Conduits and Insulators:—

Insulator for Electric Wires, D. M. Rothenberger, Lancaster, Pa., 532,101. Filed Apl. 4, 1894.
Insulator, M. D. Law, Washington, D. C., 532,160. Filed Aug. 29, 1893.
A strain insulator constructed so as to be unaffected by changes of temperature; is linked and insulated at the center.
Insulated Pipe Joint, M. J. Locke, Philadelphia, Pa., 532,398. Filed June 6, 1894.

Electro-Metallurgy:—

Process of and Apparatus for Separation of Metals, B. Moebius, New York, 532,209. Fil-d Feb. 28, 1894.
A method of refining alloys containing silver. A silver cathode is slowly passed through the bath beneath the anode close to them; the silver is deposited in a spongy or crystaline form and collected. Means are provided for preventing the anions and the cations from mixing.
Process of and Apparatus for Pickling Iron or Steel Articles, W. S. Rawson, London, Eng., 532,394. Filed Jan. 13, 1894.
Stacks the plates at short dis'ances apart and connects only the end plates with the source of current; the current is reversed at regular intervals of time.

Lamps and Appurtenances:—

Electric Arc Lamp, A. W. Richardson, Patricroft, Eng., 532,095. Filed March 2, 1894.
The main and the shunt solenoids form the base which carries all the parts to the lamp. The positive carbon is carried in a hollow tube with a self acting clutch at the bottom; as the core of the solenoid drops, the carbon is released and as the core is lifted the carbon is raised with it.
Electric Lamp Support, F. Schefold & J. Nortney, New Albany, Ind., 532,108. Filed March 1, 1894.
An automatic hook for suspending arc lamps.
Electric Lamp Support, J. Nortney, New Albany, Ind. & F. Schefold, Parkersburg, W. Va., 532,391. Filed Oct. 18, 1894.
An automatic suspension device.

Miscellaneous:—

Automatic Safety Attachment for Gas Burners, H. H. Cummings, Malden, Mass., 532,142. Filed Jan. 19, 1894.
A thermostatic circuit breaker whereby the operation of the safety device is prevented when the gas is burning. The closing of the safety circuit is retarded a short time after the opening of the cock.
Lightning Arrester, A. Wurts, Pittsburgh, Pa., 532,353. Filed Feb. 28, 1894.
Claim: A lightning arrester comprising a pair of insulating plates, a pair of sparking terminals and an interposed discharge brush, one or both of said blocks or plates having a plurality of grooves extending outward laterally from said wedge.
Lightning Arrester, A. J. Wurts, Pittsburg, Pa., 532,354. Filed Aug. 3, 1894.
Similar to the above, the discharge wedge being formed in a body of fibrous material the fibres of which extend in a direction transverse to the static discharge.

Railways and Appliances:—

Self-Adjusting Trolley, J. Corcoran, Harrisburg, Pa., 532,031. Filed Aug. 29, 1894.
Converter System for Electric Railways, G. W. Swartz, Florence, Ala., 532,118. Filed Oct. 12, 1893.
A system in which an insulated cable is tapped at frequent intervals by an interrupted bare conductor. The circuit is completed to the car by a magnetic switch acted upon by the passing car.
Supply System for Electric Railways, A. G. Wheeler, Chicago, Ill., 532,126. Filed Jan. 21, 1893.
The current can be diverted from any portion of a conductor without interrupting the current from the generator to the line, by stringing the the conductor in independent sections connected with an auxiliary conductor including circuit breakers. Also equalizes the current in the supply conductors of adjacent tracks.
Trolley Wire Clip, J. M. Anderson, Boston, Mass., 532,133. Filed July 9, 1894.
Underground Trolley Arm, P. C. Just, Chicago, Ill., 532,157. Filed Jan. 4, 1894.
Conductor, M. D. Law, Washington, D. C., 532,161. Filed Sept. 28, 1894.
A section for electric railway conductors having an L-shape with the contact flange half the width of the main portion.
Conductor Support, J. C. Love, Chicago, Ill., 532,164. Filed May 9, 1894.
An improved clamp for supporting line wires of electric railways.
Conduit for Electric Railways, J. C. Love, Chicago, Ill., 532,165. Filed May 9, 1894.
Consists in the combination with the yokes of a supplementary conduit pipe for carrying the conductors.
Tension Device for Electric Conductors, J. C. Love, Chicago, Ill., 532,166. Filed May 9, 1894.
Electric Railway Trolley, J. C. Love, Chicago, Ill., 532,167. Filed May 9, 1894.
The spring pressing the trolley against the wire acts on a separate lever arm shorter than the arm carrying the trolley.
Trolley Wire Clamp, J. C. Love, Philadelphia, Pa., 532,168. Filed July 11, 1892.
Conductor Bond for Meeting Ends of Rails of Electric Railways, P. Rieth, Chicago, Ill., 532,185. Filed June 14, 1894.
A rail bond provided with a plurality of contact stubs with thimbles within the stubs.
Trolley Support, L. T. Gibbs, Milwaukee, Wis., 532,195. Filed July 28, 1893.
The pole is mounted on bearing surfaces which permit it to rock back and forth laterally, the base being held yieldingly in an upright position.
Trolley for Electric Railways, J. C. Henry, Westfield, N. J., 532,200. Filed Sept. 27, 1889.
Claim 1:—
The combination of the flat ribbon working conductor, the trolley frame on one side thereof and the removable contact and wear plates fixed to said frame and bearing against the opposite side of said conductor.

Conduit Electric Railway, A. M Burgher, Clay City, Ky., 532,261. Filed Apl. 17, 1894.
Claim 1:—
In an electric railway system the conduit comprising the track rail, a timber laid parallel with the rail, a top plate secured to the timber and an insulating plate on the web of the rail adapted to support the line wire.
Closed Conduit for Electric Railways, F. Windle, Philadelphia, Pa., 532,302. Filed Mch. 8, 1894.
A series of contact strips held normally out of contact but pressed automatically into circuit by the passage of a car.

LETTERS TO THE EDITOR.

THE CALLENDER AUTOMATIC TELEPHONE EXCHANGE.

I appreciate highly the ample space you have given to a description of my automatic telephone exchange system, also your editorial comments thereon, but there is one suggestion in the latter which, coming from THE ELECTRICAL ENGINEER, carries the weight of a positive statement which I cannot allow to go uncontradicted. You refer to the building of small exchanges as if in that direction lay the usefulness of my system. As I have worked on a percentage basis it will readily be understood that my aim has been to provide for large exchanges, as very little percentage benefit could be derived from the application of this principle to small exchanges of 100 subscribers.

As a matter of fact I do not expect to equip exchanges of less than one or two hundred telephones—the cost of maintaining such being inconsiderable. I have already constructed a working system, the percentage features of which were adapted for an exchange of one thousand subscribers and in the demonstration of my system to be given in the Decker Building for thirty days, commencing January 23, I will show the percentage features complete for a system of 500 subscribers. In conclusion I would add that the system has no limit as to size, as the larger the exchange, the cheaper it becomes per capita.

ROMAINE CALLENDER.

NEW YORK, Jan. 11, 1895.

WESTERN NOTES.

MR. J. GRANT HIGH of the well known Philadelphia house was among the Chicago visitors last week.

THE CUSHMAN UNITED TELEPHONE CO. has been incorporated at Chicago with a capital stock of $20,000,000. They will exploit the Cushman patents, manufacture telephone appliances and construct and operate telephone and telegraph exchanges. The incorporators are I. M. Cushman, O. O. Leabhart and Joseph Barton.

MORE TELEPHONE LITIGATION.—Alfred Stromberg and Andrew Carlson filed a bill on the 5th inst. in the United States Circuit Court at Chicago, charging the Western Telephone Construction Company with infringing upon one of their telephone patents. A short time before that the last named company sued Stromberg and Carlson for alleged infringement of patents.

THE METROPOLITAN ELECTRIC CO., Chicago, have recently found it necessary to make some alterations and improvements in the arrangements of their salesrooms, so as to display to better advantage the constantly increasing line of electrical specialties the firm is handling in addition to their large stock of staple goods, in the electrical and kindred lines.

THE FONTAINE CROSSING & ELECTRICAL CO., of Detroit, Mich., are issuing a neat circular, with cut, descriptive and illustrative of their interesting Fuller double voltage dynamo which has already been referred to and discussed in these pages. Plants lately installed by the Company are Detroit, Grand Haven & Milwaukee R. R., 1800 lights; Detroit *Free Press*, 1200 lights; Louisville, New Albany & Chicago R. R. 1,000; Boy's Industrial School, Waukesha, Wis., 500.

MR. FREDERICK P. THORP, well known in electrical circles, has recently been appointed General Western Agent for the Fontaine Crossing & Electrical Company, with offices at 1020 the Rookery, Chicago. Mr. Thorp has gathered a great deal of experience through his former connections with several of the larger companies, and also the World's Columbian Exposition. In addition to looking after the business interests of the above named company, Mr. Thorp will also undertake the designing of mechanical and electrical apparatus and contract for the erection of complete lighting and power plants.

LIGHTING TROUBLES IN TACOMA, WASH.

The city of Tacoma, Wash., has filed an amended complaint in its $1,000,000 damage suit againit the Tacoma Light and Water company for having by bribery, fraud and connivance with former city officials succeeded in selling its plant to the municipality for $1,750,000. The actual value of the plant is alleged to be only $750,000, and the suit is for the difference. Serious allegations of bribery are brought against more than forty prominent citizens.

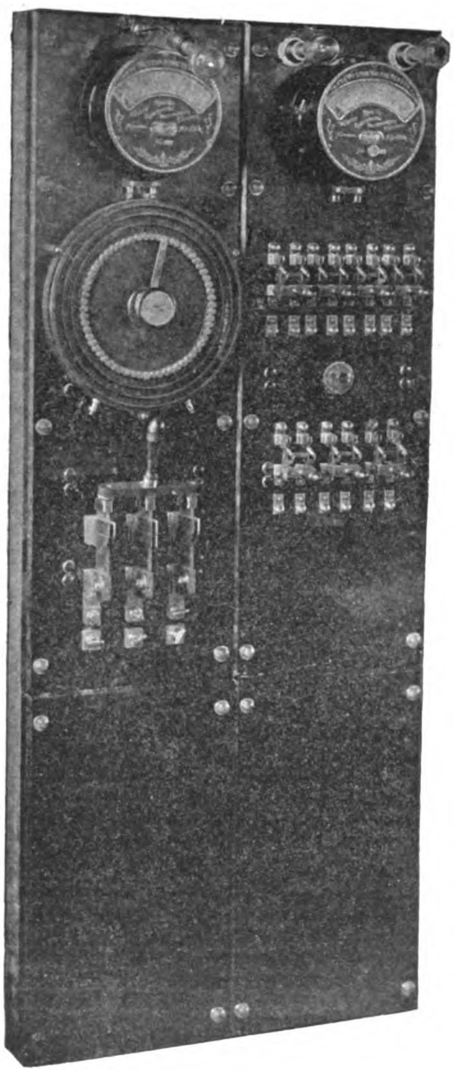
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE GENERAL ELECTRIC STANDARD PANEL SWITCHBOARDS.

ADVANCES made in the electrical arts are nowadays nearly all in the direction of economy, and the patient attention to details. As an example, in isolated plant engineering the design and construction of the switchboard has generally occupied a large amount of time with consequent expense usually out of proportion to the size of the contract. To reduce this expense the General Electric Company has standardized a form of switchboard, of the panel type, similar in this respect to those successfully employed in its railway work.

The panels are of two kinds, one for the generator and one for



GENERAL ELECTRIC STANDARD PANEL SWITCHBOARD.

the feeders. They are of black enameled slate in two finishes, mounted on a steel frame. Flanges on the frames admit of the panels being connected side by side to form one uniform whole. The generator panels are built in eleven capacities running from 8 to 100 K.W. at 125 volts, or from 24 to 800 amperes maximum, and all are 48″ high and 16″ wide.

Each generator panel carries one triple pole single-throw switch with fuses, one Carpenter enamel field rheostat, one round dial ammeter and a pilot lamp, all being electrically connected behind the panel. The common bus bars on all the panels being the same distance apart, connection of the bus bars by a copper tie bar connects the panels together electrically. Except in the method of connection the three and two wire panels do not differ from each other.

The feeder panels are made in two sizes, 48″ high by 16″ wide for the two wire and 48″ high and 26″ wide for the three wire system. The two wire panel carries a double-pole feeder switch with fuses, one round dial voltmeter reading to 125 volts, one two wire push button ground detector. The three-wire panel carries triple-pole single throw switches with safety catches, two voltmeters and one ground detector. All the connections are complete and immediate installation is effected by soldering in the feeder ends and generator leads and connecting the two bars together with tie bars.

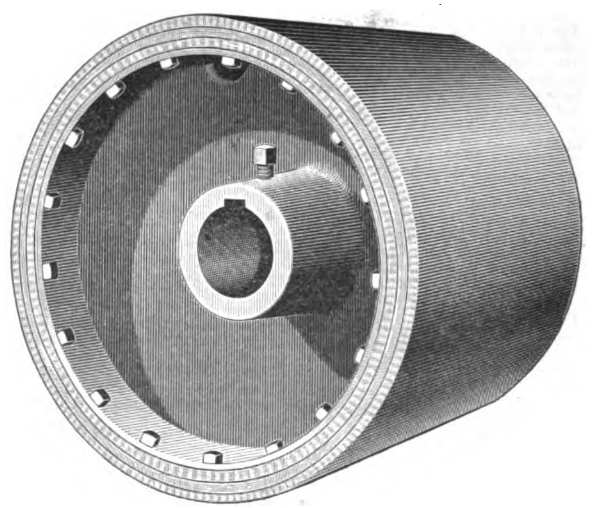
These switchboards are made for support either by brackets, upon a hollow pedestal, or the framework may be continued down to the floor and the open space filled by plank panels, as shown in the illustration. This method is generally recommended. The simplicity of construction and ease of installation of these panels together with the advantage of increasing their capacity without impairing the uniform appearance of the switchboard, have already commanded a wide appreciation among electrical engineers.

"COMPRESS" PULLEYS FOR DYNAMO DRIVING.

Probably no one thing about a central station is the source of more annoyance and, indirectly, of expense, than slipping belts. Besides ruining the belts, the tightening required to overcome slipping puts an abnormal pressure on the bearings, heating them up frequently to destruction and increasing the friction load enormously. Again the maintenance of regulation of pressure on the circuits is practically impossible with a slipping belt.

We believe therefore that our readers will be interested in the description of a pulley which has been shown to fulfill the most exacting requirements of central station work, and known as the "Compress" pulley, manufactured by the Compress Wheel Co., of 149–151 Huron St., Chicago, Ill.

As shown in the accompanying engraving, the covering of



THE "COMPRESS" PULLEY.

the "Compress" pulley consists of flatwise, abutting strips, one inch wide, of sole leather, the length of the strip being determined by the face of the pulley. These strips are set up in a ring which has a diameter of one and one half times the required diameter of the pulley. This leather ring which then has a thickness of about one inch and a width depending upon the width of face desired, is forced from the iron ring in which it is set up into and through an inverted frustum of a cone, the greater diameter of which is equal to the diameter of the ring and the smaller diameter equal to the required diameter of the pulley. In this way the diameter of the leather ring is reduced one-third and the leather strips consequently are tightly compressed. Another ring, of the diameter of the required pulley, receives the leather as it emerges from the cone and prevents expansion until the inner surface of the leather is turned smooth in a lathe, and shoulders have been cut in the ends of the leather ring, concentric with it, into which iron hoops are fitted. The whole is then slid over the rim of an iron pulley two inches less in diameter than the required pulley and fastened to it by screw-bolts through the rim of the pulley, and into the iron hoops. The retaining ring is then removed and the face turned true and crowned in a lathe.

These pulleys have been given a most severe test at the Washington St. station of the Chicago Edison Co. Two pulleys were put to work on April 7 last. One of 14 in. diameter by 12 in. face on a 1,000 light Thomson-Houston alternator, 1,500 revs. per min.; and the other 22 in. diameter by 20½ in. face on a 2,000 light Slattery alternator, 1,050 revs. per min. Both of these machines are belted from above. In the former case the distance between centres, vertically, is slightly under 15 ft. and in the latter 18 ft. A good deal of trouble with hot bearings and and slipping belt had been experienced in the past and consequently, poor regulation on the 1,000 lighter; and on the 2,000

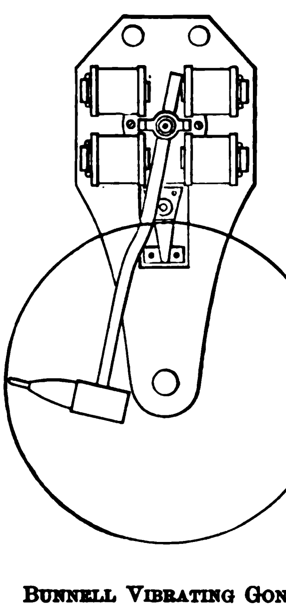
lighter it had been impossible to pull more than 40 per cent. of the rated capacity without slipping, and on tightening up the belt the bearings heated to the melting point several times.

Various kinds of pulley coverings had been tried on this machine with only temporary relief. Ever since the "Compress" pulleys have been on—9 months now—no difficulty whatever in pulling a full load has been experienced, and in fact an overload on both of these machines is now carried with slack belts and cool bearings and the regulation has practically taken care of itself. The covering is apparently as good to-day as when first put on. These machines run twenty hours a day.

To further test the efficiency of the covering the 12 in. belt on the 1,000 lighter was replaced by an old and oily 8 in. belt and it ran one week with perfect satisfaction. Of course it is not recommended reducing the width of the belt but this experiment shows what can be done. The Chicago Edison Co. have recently equipped their 500-volt power-generators with these pulleys. This service is subject to great and sudden fluctuations of load, but the effect has been a great improvement in pressure regulation and a decided saving in armature repairs is also expected.

THE BUNNELL VIBRATING GONG.

The accompanying illustration shows a new power vibrating gong recently placed upon the market by Messrs. J. H. Bunnell & Co., of 76 Cortlandt street, for railway crossings, yards and stations, hotels, fire alarms, school calls, etc. It is claimed to be the loudest and most powerful vibrating electric bell yet produced, while the action differs from all other forms in a number of respects. No springs are used. The hammer is withdrawn after its forward stroke by an extra pair of magnets with full power of the current so as to give a strong rebound to start and assist the forward stroke which is then made with the added full force of the current by a separate pair of magnets.



Bunnell Vibrating Gong.

It is claimed that the hammer moves twice as far and is about three times as heavy as in the old forms. It does not have to overcome the force of any spring in its forward stroke but is helped instead by a powerful recoil from the backward movement. The result is that with equal amount of battery the power of the actual blow delivered on the gong is fully trebled as compared with the old method.

HERRICK & BURKE.

The above new firm of electrical engineers, with offices at 203 Broadway, New York City, have issued the following notice to the trade and profession:

We take pleasure in announcing that the above named firm has been formed, and will devote itself to general designing, engineering and consulting work in the field of electrical construction of apparatus and its installation.

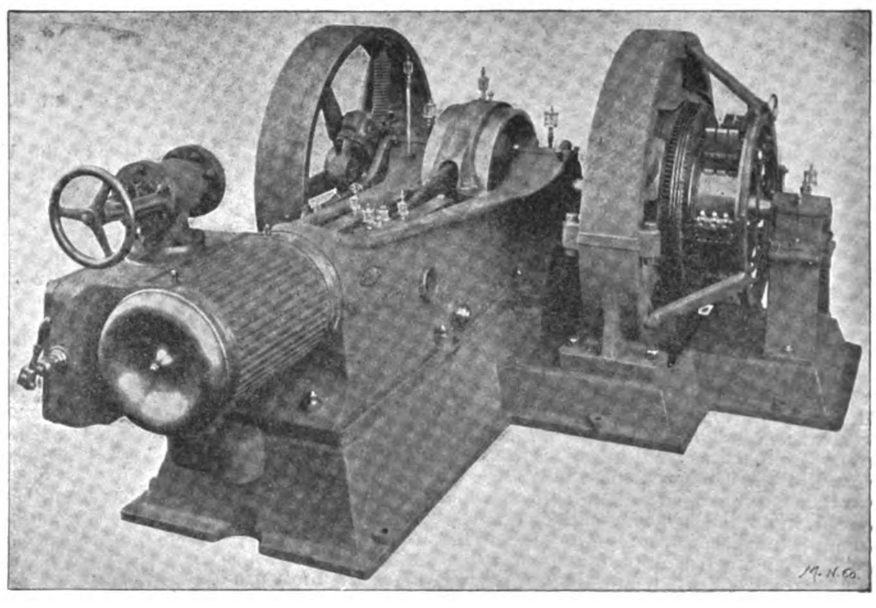
Our Mr. Herrick has been connected with electric lighting since 1879, and his experience embraces not only the manufacture of incandescent lamps, but, by successive stages, that of designing a great variety of lighting apparatus, and special devices for central station operation. Large switch-boards have been a subject of close study with him for several years, and it may be stated that nearly all, if not all, the boards in the newer modern incandescent stations have been designed and built under his guidance.

Mr. Burke has for the past six years been actively engaged in the design and construction of some af the best known street railway and stationary motors and generating apparatus, in this country. Of late, his energies have been concentrated more particularly on direct-driven dynamos, and it has also been part of his work to install and start some of the largest lighting and power plants of this character in the world.

It will be readily understood therefore, that the members of the firm have had peculiarly favorable opportunities for mastering the essential conditions involved in the economical operation of lighting and power stations. They believe that in the development of new plants, and the carrying out of new ideas in these lines, their knowledge and experience may be of value to those needing advice regarding large expenditures from which the highest possible return is naturally expected. They will therefore not only be glad to undertake such consultations and engineering work, but are also prepared to draw up specifications and plans for high grade plants and to superintend the construction of this class of work.

THE WOODBURY DIRECT CONNECTED HIGH SPEED ENGINE.

We illustrate in the accompanying engraving the "Woodbury" high speed engine, adapted for direct connection to multipolar generators. This engine is built by the Stearns Manufacturing Company, of Erie, Pa., well known for their progressive tendencies, and one of the first builders to enter the field of direct-connected engines. The general design of the engine heretofore largely employed for belt driven plants remains unaltered. The changes in proportions of parts are such as theoretical considerations, and an extensive series of practical experiments have demanded. The sub-base, additionally strengthened, is extended to carry the generator, and the main shaft is extended continuously or with flange or other coupling for the same purpose. An outboard bearing is provided in all cases, made self-oiling and adjustable.



Woodbury Direct Connected High Speed Engine.

The cut-off valve has quadruple admission and double exhaust ports, and is of the flat, perfectly balanced type, so arranged that it is absolutely non-wreckable by entrained water. Messrs. Burhorn & Granger, of 136 Liberty street, New York, are the New York agents for the sale of these engines.

A Woodbury belt driven engine of 60 H. P. has recently been installed in the Hotel Minot, 126th street and 8th avenue, New York.

A NEW COMPANY FOR CALDWELL, O.

A special dispatch from Caldwell, of Dec. 22, says:—A Cleveland company wants to erect a large manufacturing plant in this city for the manufacture of light dynamos, power motors, power generators, electric cars, including trucks and bodies complete, etc., to have a monthly pay roll of from $2,000 to $5,000. Land will probably be purchased and lots laid out and sold in order to raise the desired bonus.

THE NEW "TYPE W." C. & C. DYNAMO.

Golden opportunities have been offered designers of dynamos, in recent years, and from the appearance of the machine illustrated in the accompanying engravings it would seem as if The C. & C. Electric Company, of 143 Liberty St., New York, are anything but slow in their appreciation of this fact. It is refreshing, to say the least, to note some evidences of the advancement of the art, as practiced by dynamo builders, and one needs scarcely remark, evidences of advancement would not be hard to find in this new dynamo.

A closer inspection discloses some interesting facts about the machine; the annular steel castings constituting the magnetic field, shown in Figs. 2 and 3, are excited by a single coil, with the result, that the magnetic flux is of uniform density under the several poles, thereby obviating any tendency to spark because of any variation in the magnetic flux, as is usually the case when several exciting coils are employed unless the coils so used produce a uniform magneto-motive force, a condition hard to

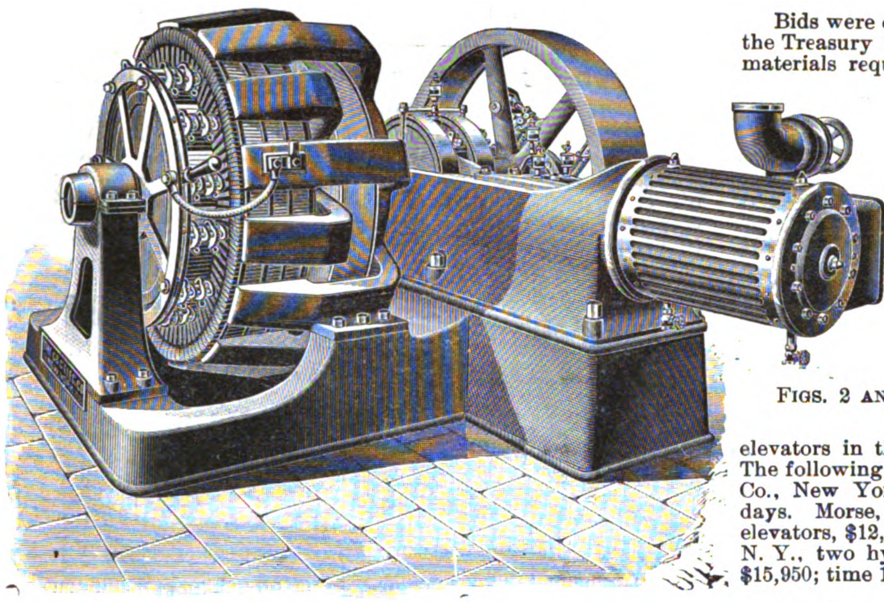


FIG. 1.—THE NEW "TYPE W." C. & C. DYNAMO.

carry out in practice. Aside from this advantage of the single coil field, the projecting arms of the magnetic frame forming the pole pieces, are situated at right angles to the direction of the air currents, and, as a result, the air currents are split up, so to speak, and greatly augment the cooling effect. An additional advantage is that the armature coils are open for inspection, and, it is said, in an emergency a coil could be removed and replaced by a new one without removing the armature from its position,—an advantage of great importance in direct connected dynamos.

The armature in the new C. & C. dynamo is of the most pronounced "ring type," the core of which is constructed of laminæ of the best magnetic material mounted on a double set of driving arms, which project from a heavy hub, keyed to the shaft. This form of construction produces powerful air currents, with their resultant cooling effect.

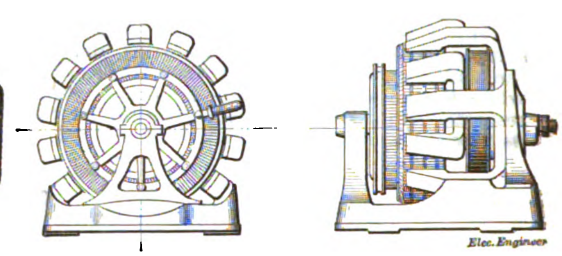
The commutator might be called a "shell type" and consists essentially of a cast bronze spider and the necessary tempered copper segments, all effectually supported and insulated by means of carefully selected and properly prepared mica of superior grade. Aside from the good effects, due to a liberally designed and well constructed commutator, this one in particular has all the characteristics necessary to cool running conditions, noteworthy among which is its open construction, and consequent freedom to the circulation of air currents.

The brushes in this dynamo are of carbon, supported in position by the now very well known C. & C. reaction brush holders, which in turn are held in rigid relation by two collector rings, of plus and minus polarity, respectively, thereby making it unnecessary to have more than two leading-in wires on a dynamo possessing a plurality of brushes.

The general design and mechanical details of this dynamo are excellent, and the facility with which it may be directly attached to engines of any of the standard makes is apparent.

The results attained with this new type of C. & C. generator have been very satisfactory indeed, for the dynamos operate under all variations in load, without sparking, even though the brushes are fixed, while the variation in pressure is less than one per cent. with the most violent fluctuation in load. Not by any means least amongst the many good points noted, is the low heating effect, which is 24° C. at full load in continuous service.

It takes courage, in these days, to market liberally designed, conservatively rated apparatus, as this low heating effect indicates this dynamo to be; yet on the other hand, the history of dynamos is too frequently blotted with "burn outs" to make it desirable to do anything but encourage the establishment of such an excellent precedent.



FIGS. 2 AND 3.—THE NEW "TYPE W." C. & C. DYNAMO.

MR. DAVID E. EVANS.

Mr. David E. Evans has been appointed electrical engineer for the city of Lynchburg, Va., to prepare plans and specifications for installing a municipal lighting plant. He will be ready to receive propositions for the work within the next three weeks.

Mr. Evans has been awarded the contract for building the Edmonson Avenue, Catonsville & Ellicott City Railway Company; also the contract for lighting the Belt tunnel for the Baltimore and Ohio Railroad Company.

PASSENGER ELEVATOR BIDS FOR NEW YORK CUSTOM HOUSE.

Bids were opened at the office of the Supervising Architect of the Treasury Department, on Dec. 27, 1894, for all the labor and materials required to furnish and erect complete two passenger elevators in the United States Custom House, New York, N. Y. The following is a list of the bidders: Sprague Electric Elevator Co., New York, N. Y., two electric elevators, $10,710; time 60 days. Morse, Williams & Co., Philadelphia, Pa., two hydraulic elevators, $12,907; time 4 months. Otis Bros. & Co., New York, N. Y., two hydraulic elevators, $18,500; two electric elevators, $15,950; time 12 weeks.

BERLIN IRON BRIDGE CO.'S CONTRACTS.

The new car barn for the Lehigh Traction Co., at Hazelton, Pa., is to be built by The Berlin Iron Bridge Co., of East Berlin, Conn. The same company have a contract for the new power house for the Keene Gas Co., at Keene, N. H.

HARTFORD, CONN.—The telephone, electric light and electric railway companies have agreed to do a good deal of work in burying their wires this summer.

NEW YORK NOTES.

MR. JEFFERSON YOUNG has been appointed manager of the New York office of the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O., at 112 Liberty street. He will handle in this section all their pumping and hydraulic mrchinery, feed water heaters and purifiers, filter presses for all purposes, water columns, tank valves, etc.

THE COLUMBIA INCANDESCENT LAMP CO. of St. Louis, in order to keep in closer touch with its large and growing business in this section has opened a New York office at 1101 Havemeyer Building, with C. I. Hills as manager and A. L. Fenton as his assistant. Mr. Hills had four years experience with Perkins and Novak lamps in responsible capacities, and has also been known for some time past as a Columbia man. Mr. Fenton was at one time in the Novak service. Both gentlemen are well informed, energetic and popular, and should do exceedingly well with so good a lamp as the Columbia is.

SING SING, N. Y.—The Berlin Iron Bridge Co., of East Berlin, Conn., are building a new power house for the Sing Sing Electric Light Co., at Sing Sing, N. Y. The building is 50 ft. wide and 100 ft. long, the roof being covered with the Bridge Company's patent anti-condensation corrugated iron.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

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THE CHICAGO EDISON COMPANY.—ITS HISTORY AND WORK.

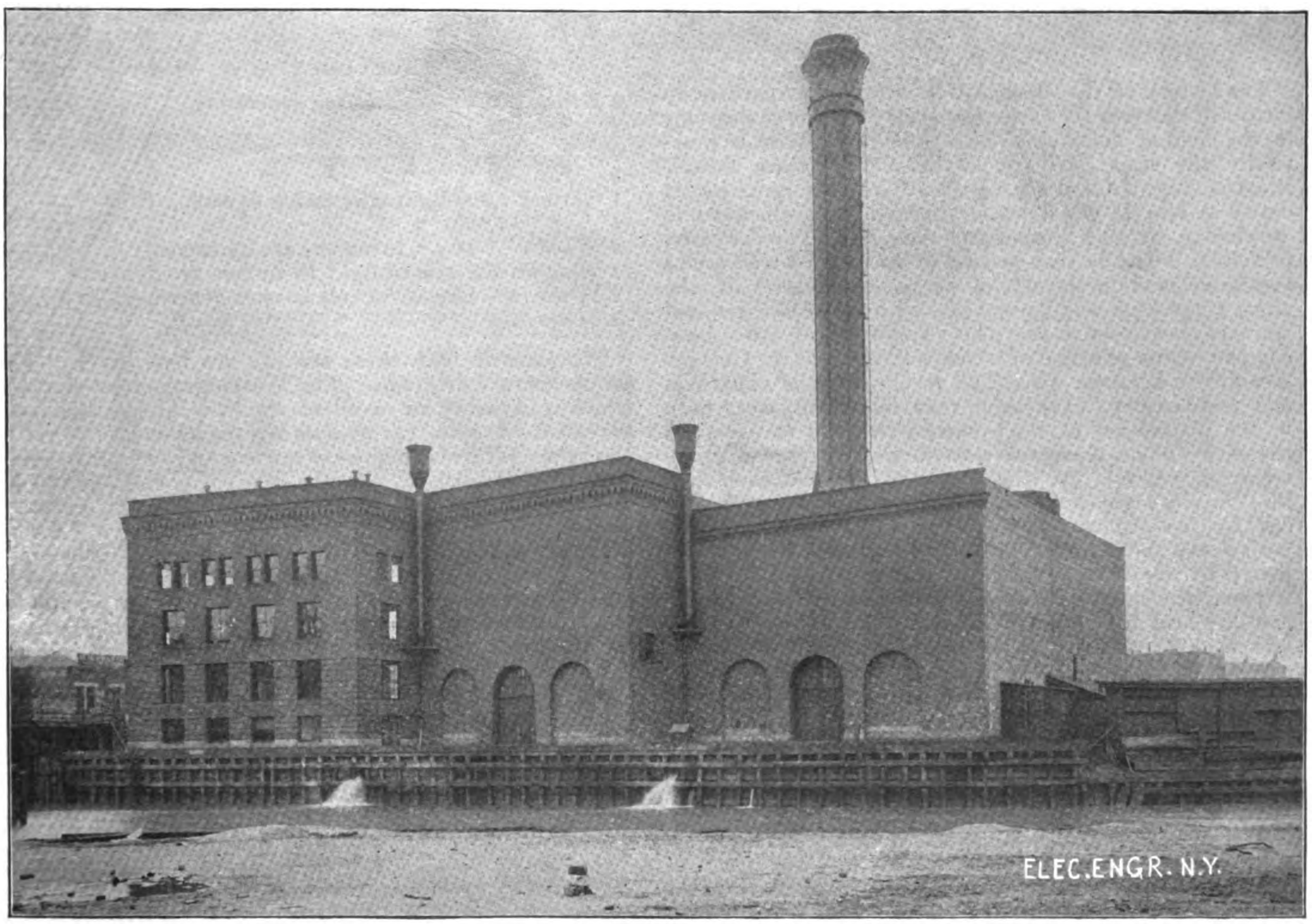
BY

T. C. Martin

I.

THE conditions that have accompanied the growth of modern Chicago express themselves more perhaps in feats of engineering than in any other respect. There has been a rapid influx of population, a vast increase in trade and manufactures, and a gigantic accumulation of new wealth; but back of all these, because of them, explaining them and ever rendering them more possible have been the engineering enterprises by which the marshy plain along the lake has become habitable, accessible and valuable. Each stage in the advance of the noble metropolis of the West is marked by the beginning or accomplishment of another triumph of the engineer, until at last one begins to think of Chicago as peculiarly the creation of the civil and mechanical arts.

A new city such as this is favorable ground for the introduction of the appliances and uses of modern electricity, and the result is that Chicago for some ten or fifteen years past has been one of the foremost electrical centres in the country. Not alone has she become a large producer and distributor, but her local electrical institutions, in whatever branch of the art, have assumed a



HARRISON STREET STATION OF THE CHICAGO EDISON CO. (See page 68).

magnitude that is simply astounding. In the domain of electric light and power the growth has been particularly remarkable, and in more than one respect out of the common. The city street lighting which in so many other communities has been the chief source of income of the local company, has remained in the hands of the municipal authorities. In Chicago, the use of underground high tension wires found its pioneer exemplification; while the uncertainties of the suburban development tended to check the organization of plants in the outlying regions where overhead wires would be permitted. Still, even under these conditions, private capital found an opening and a reward. Chicago has always needed immense quantities of artificial light. Her factories and offices are run with less regard for regular hours of business than those of any other American city. A Chicagoan always gives one the impression of getting up steam toward nightfall, when a New Yorker is putting on his gloves to go home. Besides this, the atmosphere the year around is laden with smoke and in winter is surcharged with fog rolling in from Lake Michigan. Another reason for a large consumption of light is that in Chicago as in Paris, they dearly love cheerful glare and glitter, and, as Richard Harding Davis says of the boulevards, so in Chicago, one can easily read at a fourth or fourteenth story window by the illumination from the brilliant stores and sidewalks below. It seems to the writer that these and other idiosyncracies enter into the determination of the size of a station quite as much as the canvass of any district on the normal averages of so many lights per block, per house or per head.

II.

The history of the Chicago Edison Company gathers up into itself the record of various movements and organizations in the field of commercial electric lighting. It is practically the same company as the old Western Edison Electric Light Co. Its certificate of incorporation is dated as late as April 30, 1887, and since then, while developing its own business on the regular low tension principle, it has by that process of accretion which seems inevitable and necessary in large enterprises of the class, taken over and harmonized with its productive and administrative system the plants and staffs of other local companies, the principal of which, perhaps, was the Chicago Arc Light & Power Co. The results of this expansion and readjustment have been very important, more even in the disposition of the Company's central stations and the nature of its apparatus than in the corresponding increase of capital; for the simple reason that each step, scientifically planned and carefully taken, has led to further and further economy, thus enhancing the stability and permanence of the investment. To-day the Company has, partly by choice and partly by chance, reached a most interesting strategic condition in the disposal of its equipment; and if the reader will look at the maps he will see how each of the four main central stations dominates a specific district, and serves as a nucleus for the later blending and overlapping of the whole network in one vast interconnected system. Up in the north, is the Newbury Library plant; at the central city point, is the Washington street plant; far to the south, looking into newer regions towards the World's Fair district is the Wabash avenue plant; while midway of all, its feet set by the Chicago River, one strong arm reaching out to the old Adams street station as a centre of distribution, and its other arm free to sweep the whole great western section at its back, is the superb and massive Harrison street station—by all odds the best example of electric light engineering in America. Such a system invites to further observation, and the opportunity will now be seized.

III.

It may be as well to glance at each of the stations in rough order, though we may omit Adams street and come last to the climacteric Harrison street. It will have been noted that the Chicago Edison Company has consolidated various plants or systems in its onward career, each of which was a servitor whose patronage of course it was desirable to retain. In this wise, the company has probably one of the most heterogeneous assortments of apparatus it ever fell to the lot of supervising engineers and managers to operate. This assorted apparatus has, so to speak, been lumped together in the stations at Washington street and Wabash avenue, in either of which one can get plenty of food for reflection on the peculiarities of theory and practice in dynamo construction. A mere narrative would be bald and unconvincing alongside this list which also tells how quickly we are shifting now from small units to large :—

WASHINGTON STREET STATION.

28 T.-H. 50 light 10 ampere arc dynamos, Type "MD"
3 " 35 " 10 " " " " "LD2"
3 " 30 " 10 " " " " "M"
9 " 50 " 6-7/10 " " " " "LD12"
3 Wood 80 " 10 " " " " "No. 9"
2 Edison No. 60 bipolar generators, 175 KW. as booster.
2 " No. 32 " " 100 " " "
1 Wood alternating 3,000-lt dynamo, Type "1A"
2 Slattery alternating 2,000-light dynamos " "2A"
2 T.-H. alternating 1,300-light dynamos, " "A70"
1 T.-H. " 1,000 " " " "A50"
1 T.-H. direct 500 volt, 250 KW. gen. " "MP250"
1 T.-H. " 500 " 80 KW. " " "MP80"
3 T.-H. " 500 " 62 KW. " " "D62"

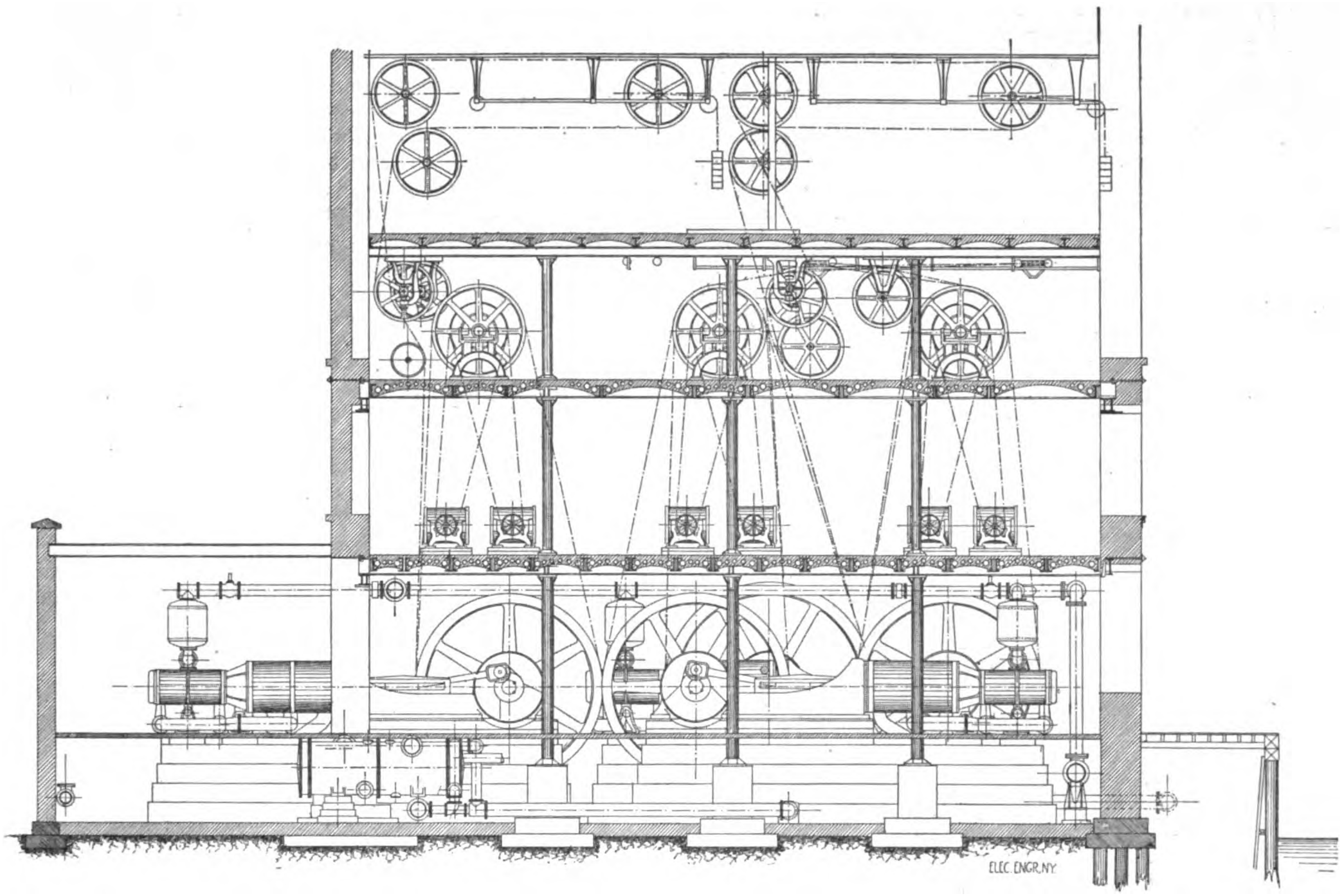
WABASH AVE. AND 27TH ST. PLANT.

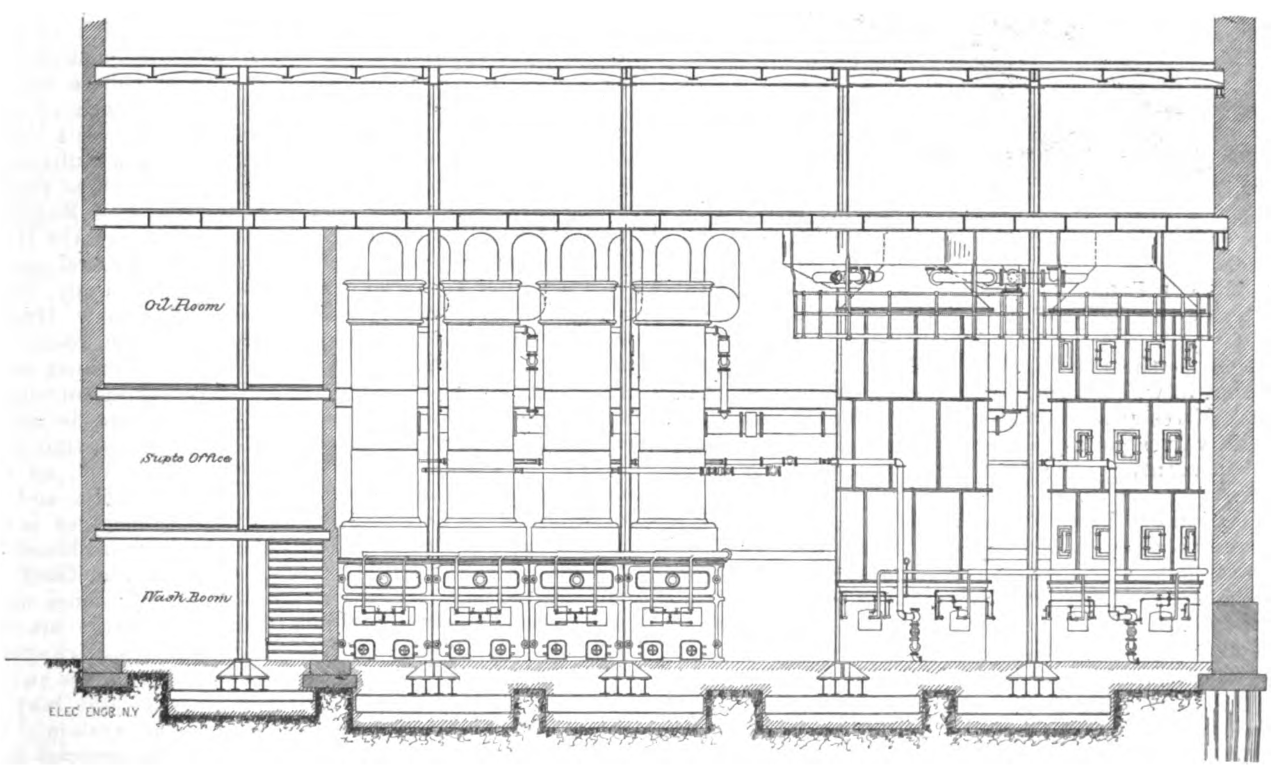
2 Edison 200 KW. multipolar generators,
2 " 75 " " "
6 " 100 " bipolar "
2 " 60 " " "
1 Slattery 2,000 light alternating dynamo, Type "2A"
1 " 1,200 " " " " "3A"
2 Wood 80 " 10 ampere arc dynamos, " "9"
2 Western Electric 60 light 10 ampere arc dynamos.
2 $7\frac{1}{2}$ KW. 300 ampere 25 volt booster generators.
2 30 KW. 500 " 60 " " "

The plans of both these stations are here given, with supplementary diagrams. The Washington street station, which is in reality an excellent specimen of the standard arc plant of quite recent date has for its motive power 6 handsome Williams engines, 5 tandem and one cross compound, of a total 3,450 H. P., the cross compound being 1,000 H. P. It has also the unusual feature of containing no fewer than 12 vertical boilers, fired with fuel oil—4 Climax (Morrin) of 500 H. P. each, and 8 Manning (Bigelow) of 150 H. P. each. The exigencies of the case required the use of vertical boilers, but it is stated by the engineers of the company that the results have been most satisfactory on all scores. It will be observed that there is a distinct shafting floor, with its long lines of shafts, pulleys, friction clutches, etc., due to the conditions of a variety of apparatus and the employment of small units; and, of course, the net efficiency under the most efficient supervision will not be the highest. It is nevertheless surprisingly good.

Turning to Wabash avenue, we find an even greater diversity of steam plant, as it comprises one 135 H. P. McIntosh & Seymour engine; two 200 H. P. McIntosh & Seymour; two 150 H. P. Armington & Sims engines and one 250 H. P. A. & S.; a 200 H. P. Ideal; a Lake Erie 200 H. P. vertical, two Ball & Wood horizontal engines of 150 H. P. each and a new type Ball & Wood vertical of 600 H. P. The booster sets are driven by motors direct connected. The boilers are 4 Heine of 375 H. P. each, which were using natural gas but are now fired with coal.

The new type of Ball & Wood vertical compound at Wabash avenue is a distinct new departure in central

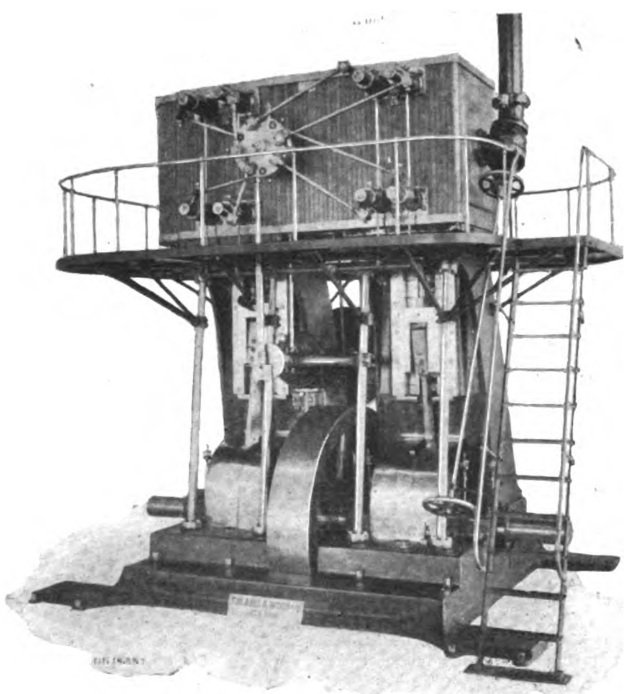




Sectional Views of Boiler Room, Dynamo Room, Engine Floor, &c., of Washington Street Station of the Chicago Edison Co.

station practice and deserves one or two special words. The cylinders are 19 inches and 31 inches in diameter with a 24 inch stroke, and the engine runs at 150 revolutions with 125 lbs. initial pressure. The best steam distribution is obtained, it is thought, with some form or modification of the Corliss wrist plate motion and valves, and the smallest possible clearance is obtained by placing these valves in the cylinder heads. This arrangement, then, has been adopted in the engine under consideration. The Corliss releasing gear practically limits the rotative speed to about 100 revolutions per minute, or less, but in this engine the automatic cut-off is obtained by independently operated cut-off valves placed inside the steam valves, and actuated by a specially designed governor. This arrangement places no restriction on rotative speed, which is decided by other considerations, and the aim has been to find a medium unobjectionable to the slow speed advocates.

The governing mechanism of the engine is of special interest to the student of valve gears. Beginning with a well-known form of shaft governor, the close regulation thus obtained is made effective by transmitting the neces-



Ball & Wood Engine in Wabash Ave. Station of the Chicago Edison Co.

sary motion to the cut-off valves through a special wrist plate device, in which a compound motion is obtained, and the cut-off valves at all points of cut-off operate relatively to the main valves just as though the latter were standing still, thus preventing wire drawing of steam at any point of cut-off.

The location of the valves in the cylinder head, giving as it does the shortest possible ports, admits of their being of ample capacity without an appreciable increase of clearance. The peculiar motion of the cut-off valve utilizes these wide ports to the fullest possible extent, and the cut-off motion at every point from zero to three-quarter stroke is a rapid one, in fact as rapid as is obtained from the releasing gear, because of the higher rotative speed of the engine. Another feature of great importance in this gear, particularly with compound engines, or where moments of excessive overload occur, is its ability to cut off at three-quarter stroke, while the ordinary Corliss gear is limited to about half-stroke. This engine is driving two Edison generators and, while no formal tests have been made of its performance, it demonstrates so far as one can judge that in its practical operation its economy and regulation are fully up to the expectations of its builders.

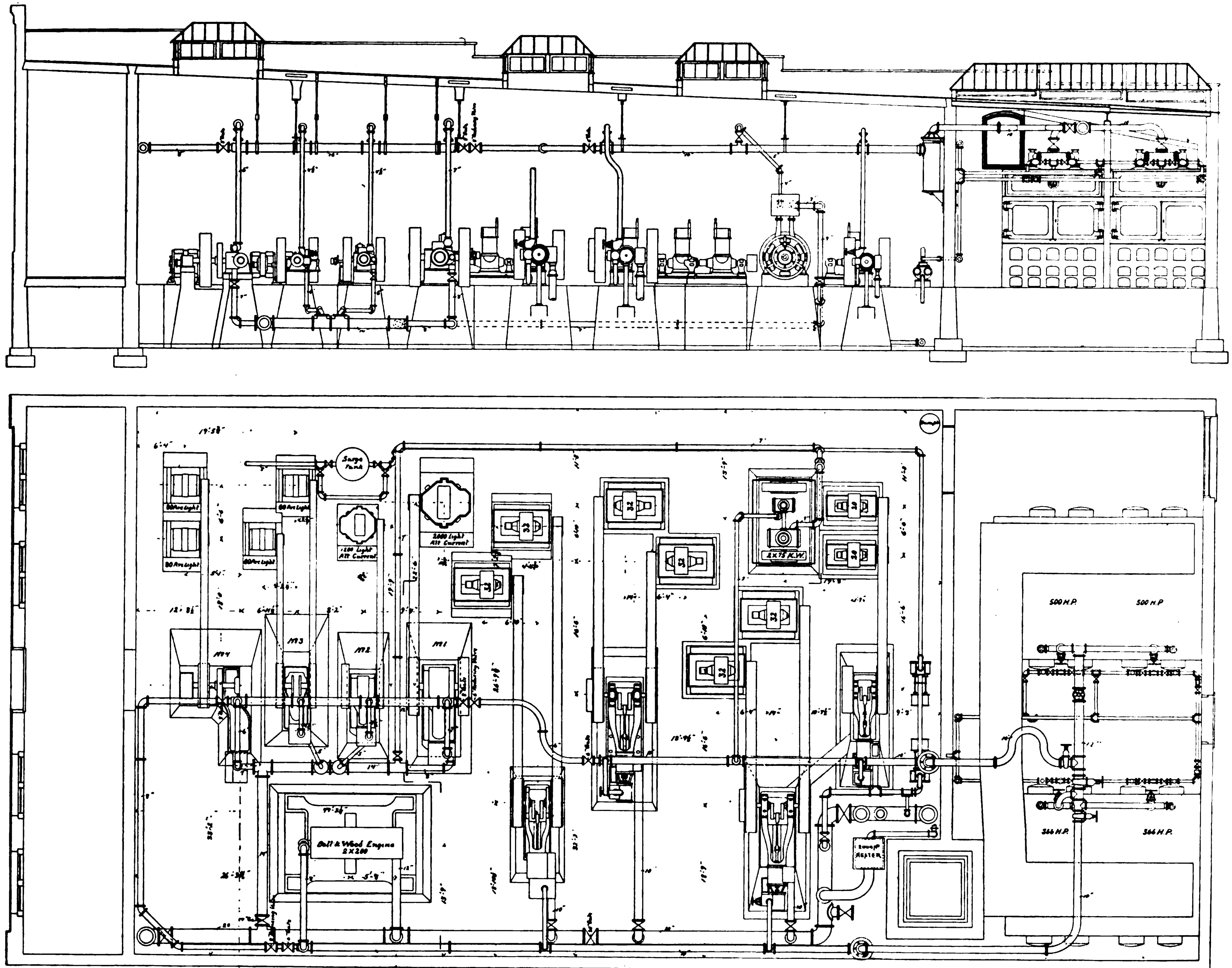
The variety of engines is, of course, due to adaptation to particular classes of light and power service. Washington street has, in addition to lighting, a large, separate power load, and its boosting system to keep up the potential at the ends of the regular three wire system. In the Wabash avenue station, the 7½ KW. boosters are used in series with the feeder running to Fourteenth street in the rear of Michigan avenue. The booster is wound for 300 amp. and 25 volts, and guarantees the pressure at a distance of 9,000 feet from the station, *i. e.*, up to the Lake Front. The pair of 30 KW. boosters are connected in series with the feeder running to Sixteenth street on Michigan avenue; they are wound for 60 volts and 500 amp. and protect the pressure at a distance of 6,000 feet.

The alternating current system of the Company is divided into two districts, one being fed from the Washington Street station, the other being fed from the Wabash Ave. station. One of the maps shows this service. A new line employing the National conduit system of cement lined pipe is now being constructed on Milwaukee Ave. running from Washington St. to the corner of Ashland Ave. and Milwaukee Ave., a distance of two miles. This system is being constructed using two feeders transmitting the current at 1,100 volts feeding into large transformers located 1,400 feet apart, the current being distributed on the three wire, 208 volt, system from the secondaries of the large transformers.

The 500 volt power system of the Company is fed entirely from the Washington street station, supplying power in a portion of the down-town district, and also a portion of the West Side.

IV.

After the miscellaneity of these two big plants, the uniformity of the bijou station back of the Newbury Library is a positive rest to the mind and eye, and in a way prepares us for the grander exemplification of the same principles awaiting our notice over in Harrison street. Such a cosy bright little plant, the pink of neatness and cleanliness, deserves its close association with the centre of sweetness and light under whose wing it nestles so unobtrusively as to escape the glance of most Northsiders passing by. This station comprises 4 Edison 75 K.W. multipolar generators and two 50 K.W. multipolars. These are direct connected to and driven by three vertical cross compound engines made by the Lake Erie Engineering Works of Buffalo. The two boilers are of the Heine make, and are of a total 565 h. p. capacity. Natural gas has been used for fuel, but owing to lessened supply, coal is used now and the furnaces are of the new Hawley pattern. The auxiliary apparatus in the boiler room comprises a fine 1,000 h. p. Warren Webster exhaust steam feed water heater and purifier; and a Worthington vertical feed pump of the Admiralty type. There is also a Worthington low service pump. In the dynamo room there is an absolute freedom from complication, all that one sees being the three direct-connected units and the switchboard. The output of the larger machines is 550 amperes at 135 volts and of the smaller machines 367 amperes at 135 volts. The leads are carried from the dynamos to the board, in brick and cement trenches under the floor; and the two machines of any combination are ordinarily used together, one on each side of the 3-wire system but are provided with change over switches on the switchboard so that the two dynamos of one unit may be thrown instantly on either side of the system. The switchboard is of white Tennessee marble secured to an iron frame by heavy copper bolts, and the whole braced by anchors in the rear wall, access to the roomy rear being obtained through a marble door. The board is in separate divisions—testing, regulating and feeder—with the usual instruments, among which the Weston are notable.



ELEVATION AND PLAN OF THE WABASH AVENUE STATION OF THE CHICAGO EDISON CO.

Crowning the board are incandescent lamps. The bus bars run the entire length of the board and are 2½ inch by ½ inch, supported in porcelain brackets on saddles. Outside the station, the circuits are all carried by the regular Edison iron tube system, and the district is taken care of by means of 15 sets of feeders. This station, which is in reality a beautiful example of careful work, is still in the formative stage, ample provision having been made for growth and the installation of new apparatus.

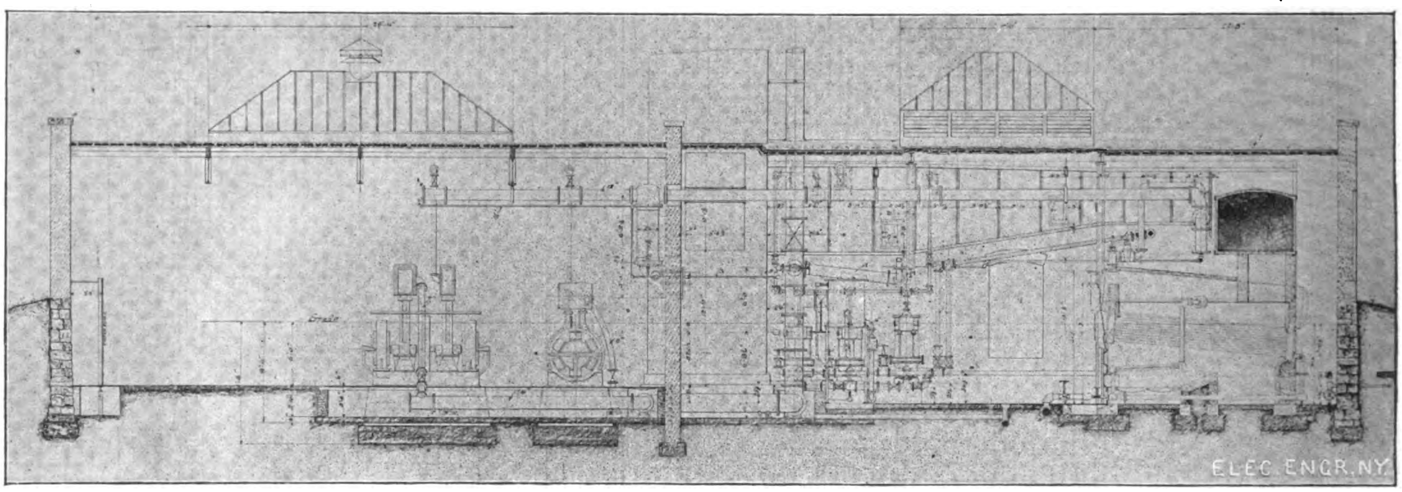
V.

The remaining station to which we will now direct our attention is that at Harrison street, on the western bank of the Chicago river. The selection of the site when the pioneer Adams street station had outlived its early opportunities, was a matter of no small importance, in view of the largeness of the new investment and the future requirements of the business of selling current for light and power. After a most thorough study of all the conditions, and a minute survey of the whole territory, a dry dock was bought and in September, 1892, the Company took possession, beginning to dredge without a moment's delay, and to drive the piling necessary for a foundation. The property fronts on the north branch of the river, backs on the Panhandle and Chicago & Alton Railroads, and aligns with Harrison street on the south. The framework of the huge building is of steel, as shown in one of the views, and the filling and facing is of red and ordinary brick. The structure is independent of the engine piers. The dimensions of the superb engine and dynamo room are 209 feet 4 in. in length by 62 feet in width ; height 60 feet ; while the boiler room is 111 feet 4 in. by 72 feet, and is intended to be 184 feet when the full capacity of the plant is reached. These rooms are lighted almost entirely from the roof, as there are no windows in the side walls, and only small ones at the end of the engine room. Between these two main operating departments is a thick fire wall, with two small openings under the smoke stack closed by fire doors. The spacious engine room is faced with a cheerful cream-colored pressed brick, and with its brightly painted colossi of direct-connected units, its polished hand rails, lofty white marble switchboard, and shining instruments, presents an appearance at once grandiose and inspiriting. To a musician it suggests a great concert hall with central keyboard controlling the two stately rows of deep-voiced organs along the aisle ; to the more prosaic mechanical engineer, it has the air of a gigantic and enlarged steam room of some ocean liner. Certainly never before was the similarity between the latest developments in electrical current generation and those of the most advanced marine engineering made so apparent.

Besides the broad central passage between the two lines of engines, there are alleys at the rear, so that everything is accessible. The switchboard is supported on bronze columns, and one can freely move about under, in front of or behind it. For the better handling of machinery an 18-ton Yale & Towne electric crane, with 3 Westinghouse motors, runs overhead the full length of the room. The space reserved for extensions is at the end farthest from the switchboard, so that as each new unit is added there is no confusion, little noise, and a simple lengthening of the vista. In a separate five-story wing of the building on Harrison street, are the offices of the station, including supply and store rooms, clerical rooms, dressing, wash and bath rooms for the operating staff, and a variety of other incidental provision.

VI.

The boiler room is arranged to accommodate 14 Heine boilers, of which 7 are now set and in use, space being laid out opposite for the others. Each boiler has 3800 feet of heating service, and is rated at 500 h. p. on a 30 pound steam basis. With the 5 boilers that are in normal, steady employ, the company was turning out while the writer was in Chicago last November 24,000 amp. at 140 volts switchboard pressure, or in the neighborhood of 5500 h. p. of electrical energy. The boilers were set with the Hawley downdraft grate attachment for coal, but they are now fed entirely with residuum oil, supplied by the Whiting, Ind., refineries of the Standard Oil Co. The daily consumption is about 9,000 gallons. The oil is stored in 4 tanks underground (construction as shown) each 8 ft. in diameter and 25 feet long. Each tank is in a brick vault by itself, and each has a capacity of 9,300 gallons. This gives 4½ days storage on the present basis of operation. The oil supply is brought up in ordinary tanks simply switched in from the railroad, emptied and dismissed. It is pumped out by an ordinary Blake pump which discharges into an air chamber and the oil goes thence to the furnace burners. The idea is to keep up a uniform pressure despite the pulsation of the pump, and the arrangement of the pump is such that this is satisfactorily effected. There are 5 burners under each boiler, but some interesting tests as to heat diffusion are being made with groups of 15. The atomizing of the oil at the mouth of the burners is done by steam taken direct from the boilers through a reducing valve, so that the pressure at the burner is 60 pounds. The boilers themselves work at 175 pounds pressure, with the safety valves set at 180. It is the intention later on to equip the boiler plant with the best type of economizers, for which owing to the excellent construction of the room there is abundant space.

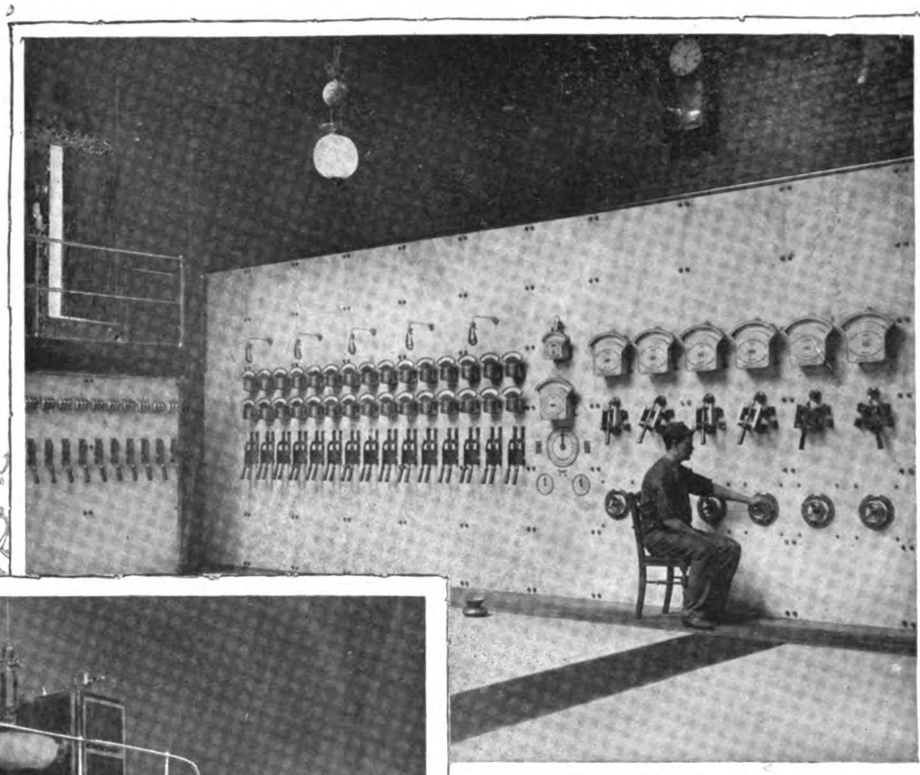


SECTIONAL VIEW, NEWBURY LIBRARY STATION, CHICAGO EDISON CO.

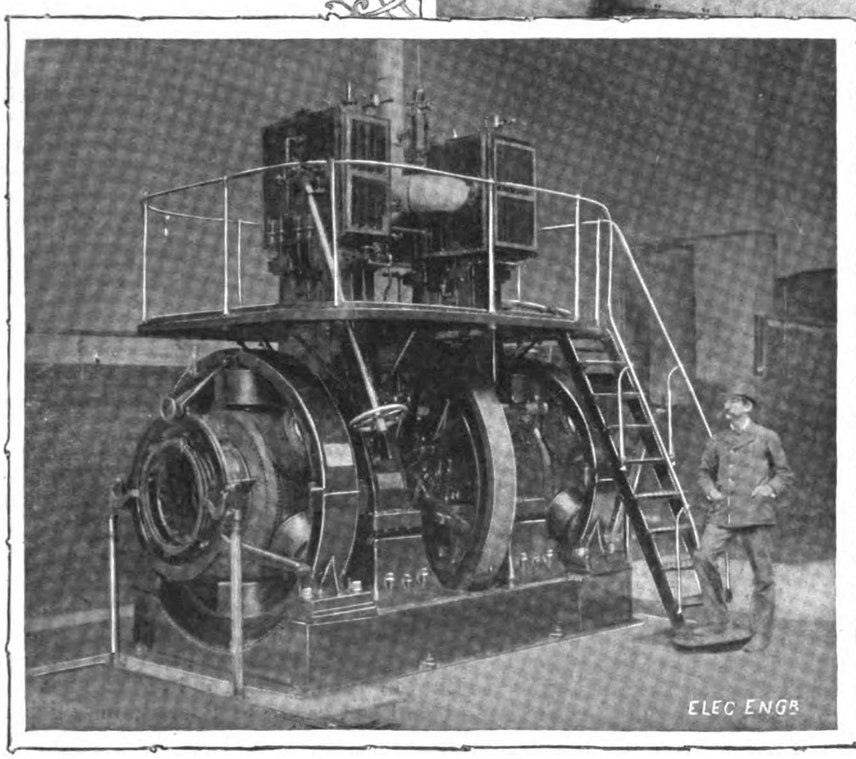
The trusses of the boiler room are adjusted to carry at least 250 tons of coal, should an emergency arise necessitating the use of that fuel.

The water supply, except for the office building, is taken entirely from the Chicago River, which does not impress one at first as being the likeliest source of supply in the world. But the slimy inflow passes through 3 Jewell filters of a capacity of 20,000 gallons an hour. It is taken in first through a crib which has gratings to screen off the debris. It goes into the plant through the circulating pump system which comprises 2 Worthington compound pumps, each having 2 high pressure steam cylinders, 10 in. in diameter; 2 low pressure, each 18 in. in diam.; 2 double acting water pistons 26 in. in diam.; and all of 18 in. stroke. The pumps are guaranteed to deliver 5,000 gallons per minute against a head of 15 feet.

The flue from the boilers is made of steel lined with fire brick. The steel and iron smoke stack rises to a height of 184 feet from the ground and has a diameter of 13 feet 8 in. It is carried on 4 steel pillars braced together extending from the floor up through the roof. It consists of one shell and is lined with



NEWBURY LIBRARY PLANT, SWITCH BOARD.



CORNER OF NEWBURY LIBRARY CENTRAL STATION OF THE CHICAGO EDISON CO.

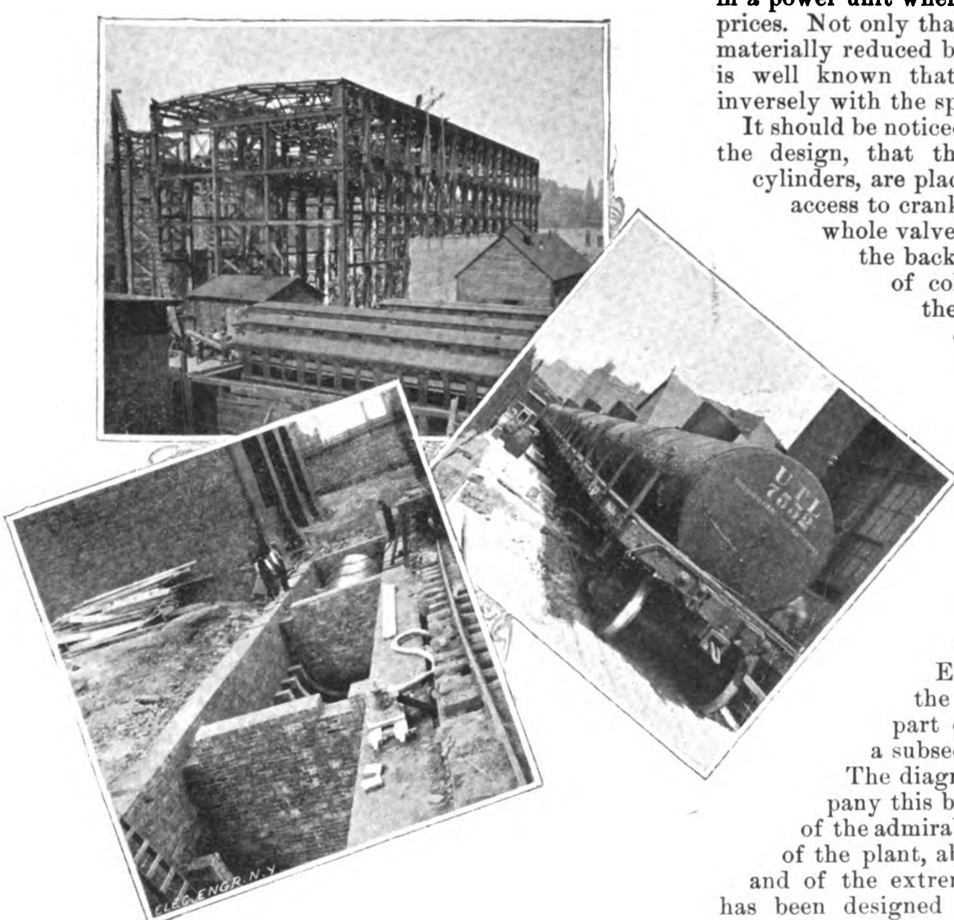
brick half way up. It is in reality self supporting, and withstands severe wind pressure with the utmost ease and indifference. The thickness of skin runs from $\frac{1}{2}$ inch at the bottom to $\frac{3}{8}$ in. at the top. It is built up by means of two conjoined angle irons on the outside making at their junctures a "T," and at the top meets a thin galvanized iron cornice flared out. When the boiler room is fully extended, there will be four of these stacks, and the steel pillars have lately been set for the second of them. The total height of the iron work from the very foundation up to the cap is 207 feet 5 in.

It is a great pity that more of the numerous power plants and factories in Chicago could not use oil. When carrying a load of 50,000 lights, the Harrison street station gives off a mere streamer of gauzy haze; but nearby one can see little coal-run shops of at most 100 H. P. heaving into the ambient gloom of the city portentous rolls and folds of soot and smut that shut in the scene with funereal darkness. In respect of the use of fuel, the Chicago Edison Company at more than one of its stations is certainly setting a noble example. Indeed one would hardly expect less from the producers of electric light.

VII.

The equipment of the engine room comprises 10 large triple expansion units, of varying size, each of the 10 engines carrying 2 General Electric multipolar generators. The 4 smaller engines drive two 200 K.W. generators each; and the 6 larger ones drive two 400 K.W. generators each; making a total present capacity of 6400 K.W. or close upon 10,000 H. P. Two of these units known as the Edison are familiar in connection with the World's Fair; the other 8 engines have been furnished under special contract by the Southwark Foundry & Machine Co., of Philadelphia, while the generators embody the latest improvements of the General Electric Co. The "Edison" engines have cylinders $22\frac{1}{2}$ in., $33\frac{1}{8}$ in. and $53\frac{3}{8}$ in. respectively, with 36 inch stroke; the 4 large Southwarks are 20 by $30\frac{1}{2}$ by 50 inch and 36 inch stroke; the small Southwarks are $13\frac{1}{2}$ by $21\frac{1}{2}$ by 36 and 30 inch stroke. Each engine is so arranged as to exhaust into the air automatically in case the condensing

apparatus should get out of order. The smaller engines have each an independent surface condenser of the Wheeler type. The condensers are provided with seamless drawn brass tubes, tinned inside and outside and packed with screw ferrules of special design. The 4 large Southwark engines have Wheeler surface condensers of the same type but double the capacity. The Edison engines have surface condensers built in the bed plate of each engine. The air pumps of the small engines are of the Worthington type, having two steam cylinders $7\frac{1}{2}$ in. diameter and two double acting air pistons $10\frac{1}{4}$ in. diam., all of 10 in. stroke. The air pumps for the Edisons are located in the bed plates. Their two steam cylinders are each 12 in. diam., and they have two double acting air pistons, 15 in. diam., all of 15 inch stroke. Each pair of the 4 large Southwarks is operated by a vertical twin



STATION FRAMEWORK AND OIL SUPPLY, HARRISON ST.

Blake air pump of the U. S. Navy pattern similar to those in use on the latest Cramp cruisers. Each Blake air pump has 10 in. steam cylinders and 22 in. air cylinders.

The Southwark Engines are, the writer believes, the highest speed vertical engines of their size running direct connected to dynamos, that have as yet been made. The smaller engines, driving two 200 K. W. generators, run at 157 revolutions; the larger, driving two 400 K. W. generators, run at 128 revolutions. Other peculiar features are at once noticeable in these engines, making them in reality a radical departure from the beaten path of steam engineering. The first one of these, is the arrangement of the cylinders, which are placed with the high pressure in the middle and the intermediate and low pressure consequently working the end cranks. By this arrangement space is gained. To further increase the saving of floor space, and make the engine compact and rigid, the whole motion for the valves is taken from the connecting rod. There is a special valve gear, in connection with a stationary link, which gives the admission and exhaust valves an independent motion. The high pressure admission valves are regulated by the governor; the others are adjustable by hand, while the engine is in motion.

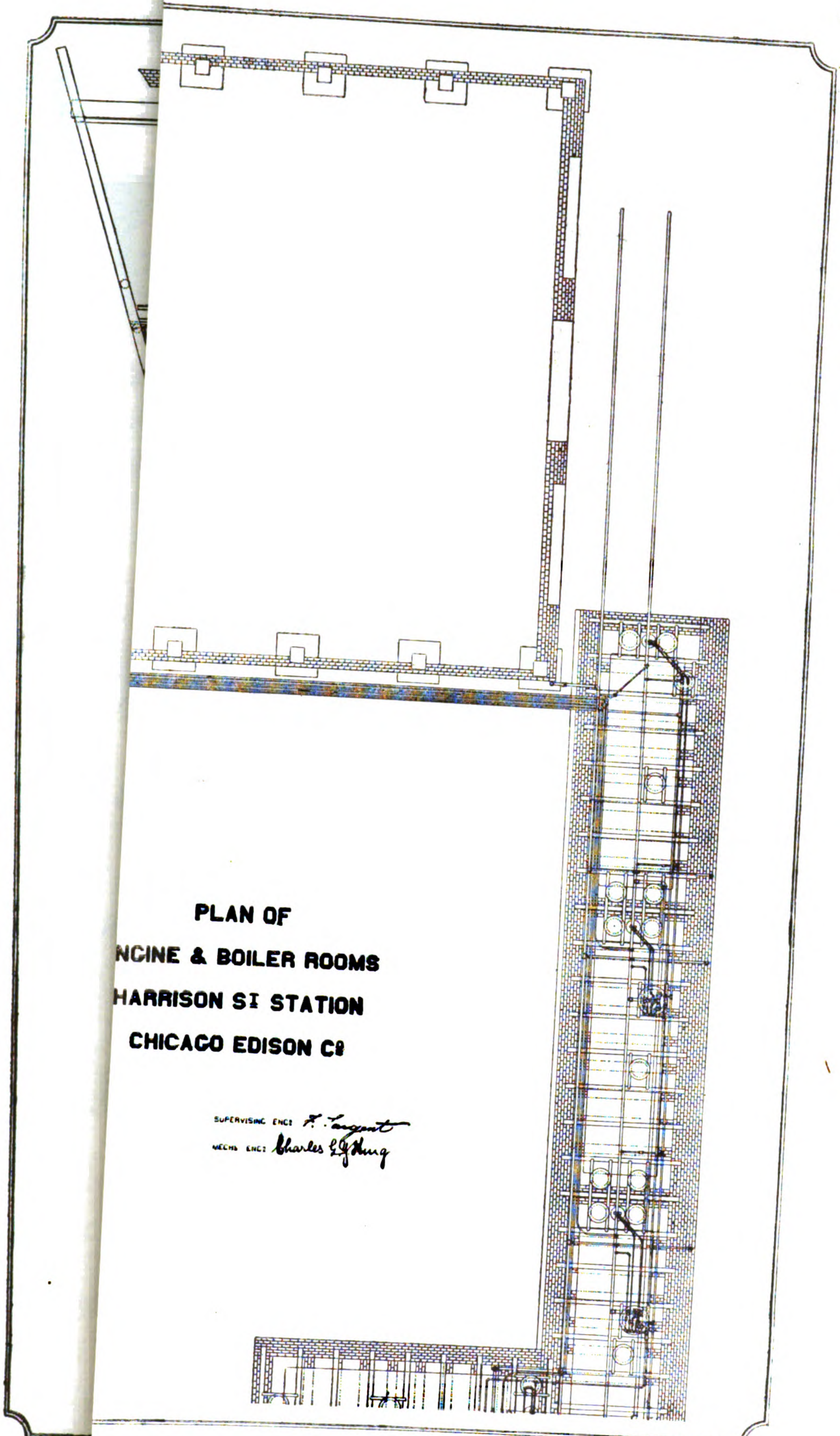
All valve stems are provided with means of independent adjustment of the valves for changing lap and lead without opening any of the valve chests. The exhaust valves can have stroke and angular advance changed entirely independent of the admission valves, although they receive their motion from the radius rod that takes the motion off the connecting rod for the other valves.

By the adoption of the special and patented features referred to above, the builders were enabled to increase the speed of the engine, and at the same time save fifty per cent. of the floor space usually occupied by units of the respective sizes. This is, of course, a very desirable feature in a power unit where real estate can be had only at high prices. Not only that, but the cost of the unit itself is also materially reduced both as to engines and dynamos, as it is well known that the weight of the dynamo varies inversely with the speed.

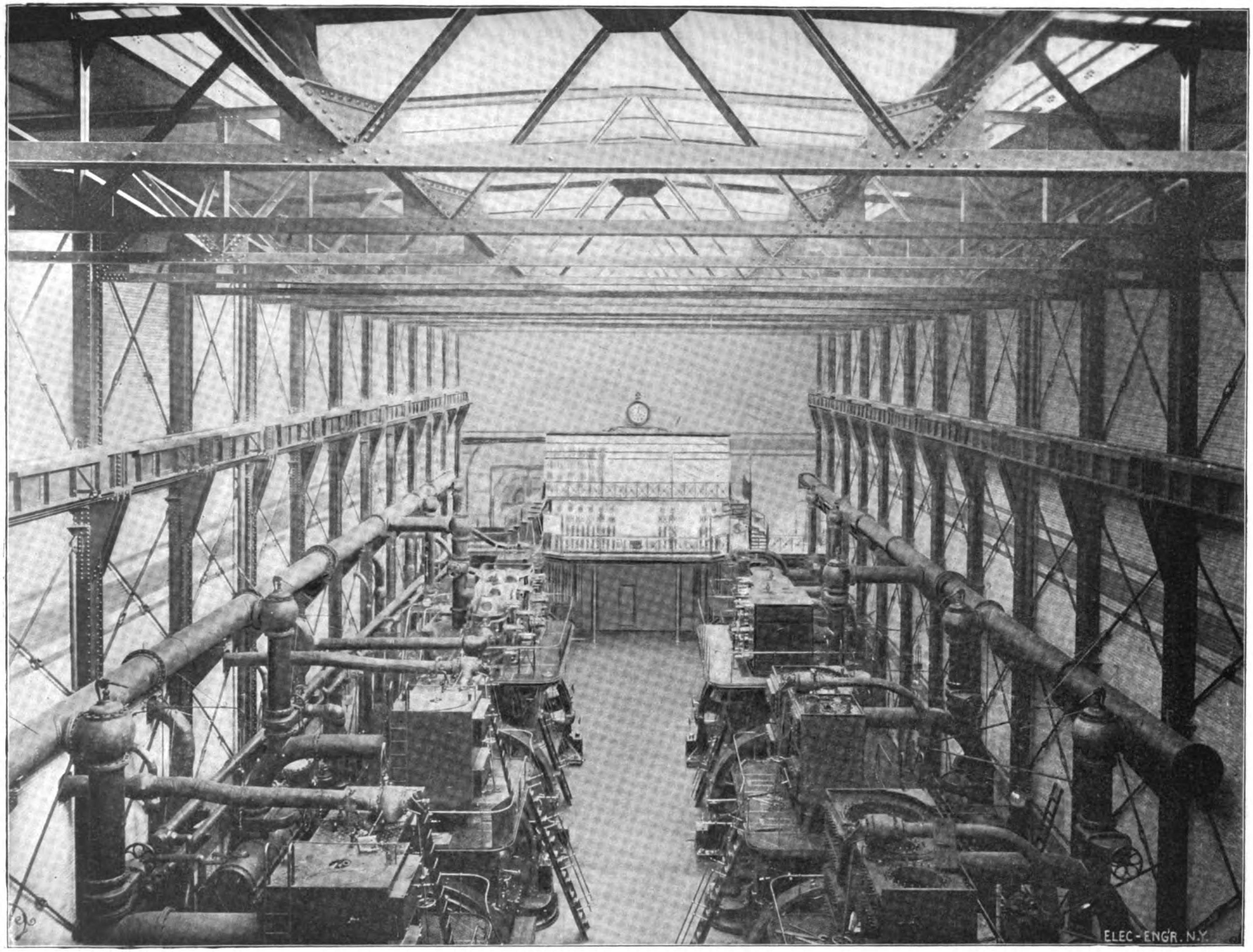
It should be noticed, notwithstanding the compactness of the design, that the columns or housings carrying the cylinders, are placed in such a position as to give free access to cranks, crossheads, connecting rods and the whole valve gear, from the front as well as from the back. That is to say, there are four sets of columns instead of three, thus placing the cranks centrally between each set of columns, rather than behind them, as is usually the case in the designs of such engines.

The engines have been subjected to a series of expert tests both as to regulation and economy, and have, it is said, responded in a degree that has surpassed anything as yet done in central station work. The detailed report of the experts' test, made by Mr. Collins on the part of the Chicago Edison Co. and Professor Spangler, of the University of Pennsylvania, on the part of the builders, will be published in a subsequent issue.

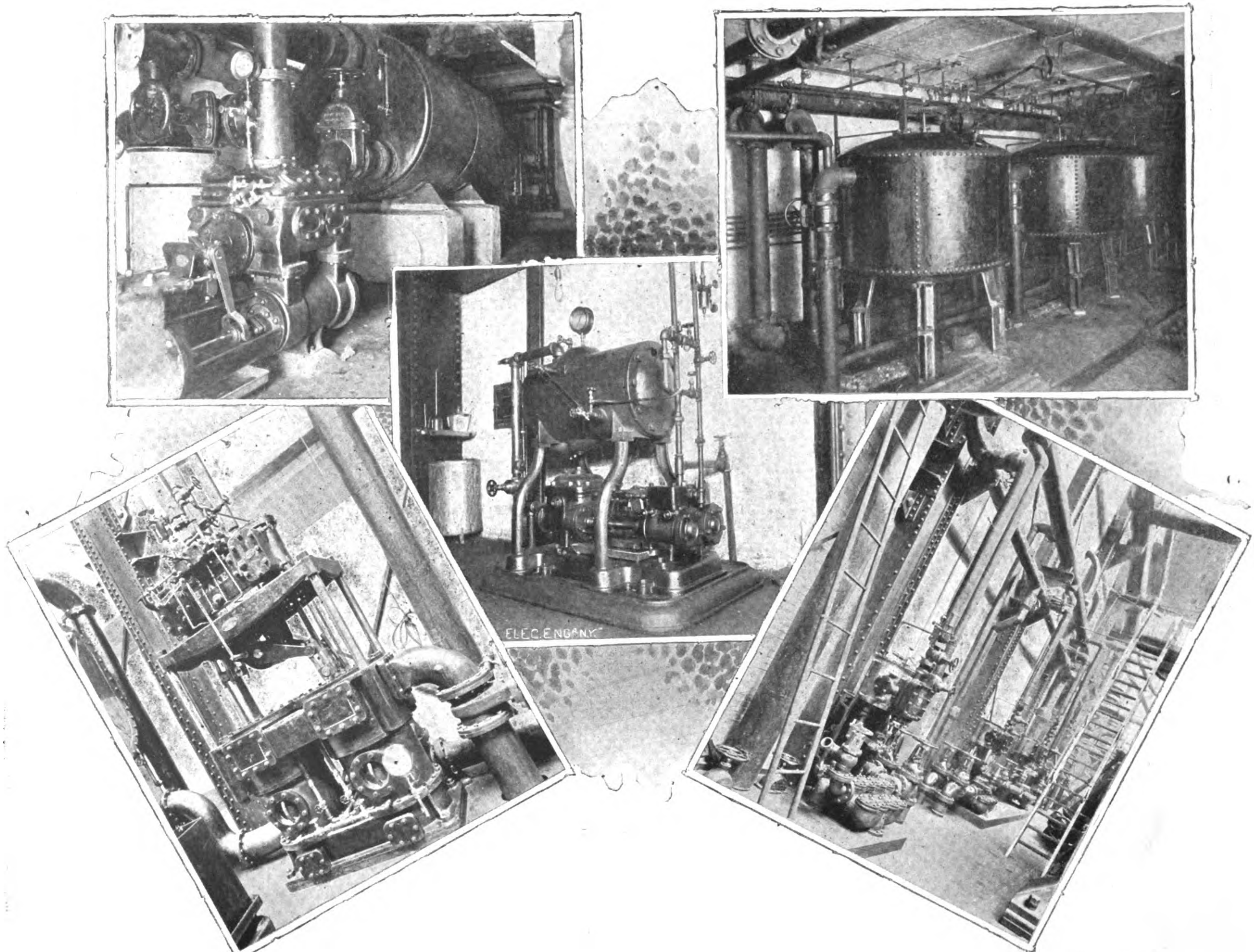
The diagrams, plans and elevations that accompany this brief description, will give a fair idea of the admirably laid out and well built steam piping of the plant, above and under the engine room floors, and of the extreme care and foresight with which it has been designed to secure the highest efficiency and economy. The perspective cuts will give a further idea of the appearance of the engine room, etc., and of the various details that go to the make-up of the steam plant. It should be added, before passing on to the electrical outfit, that the feedwater heating apparatus is of the Worthington type, corresponding to that used aboard the American liner, "City of Paris"; in which the exhaust steam from the auxiliary appliances is actually mixed with the feed water, much on the same principle as that of a jet condenser. The combined mixture goes through the feed pumps to the boiler. The feed water heater having to be placed at a higher elevation than the feed pumps, to enable them to pump hot water successfully, and the feed pumps being on the same level as the engine room floor, while the hot well is in the basement—a low service Worthington pump is used to take the water from the hot well, pass it through the Jewell filters and thence to the feed water heater. In all, there are three feed water pumps used, of the Worthington Admiralty type.



hicago Edison Co.



Interior of the Engine Room from Electric Crane, Harrison Street Station, Chicago Edison Co.



WORTHINGTON PUMP AND HOTWELL.
BLAKE PUMP.

OIL PUMP UNDER SMOKESTACK.

FILTER FOR CHICAGO RIVER WATER.
BOILER FEED PUMPS.

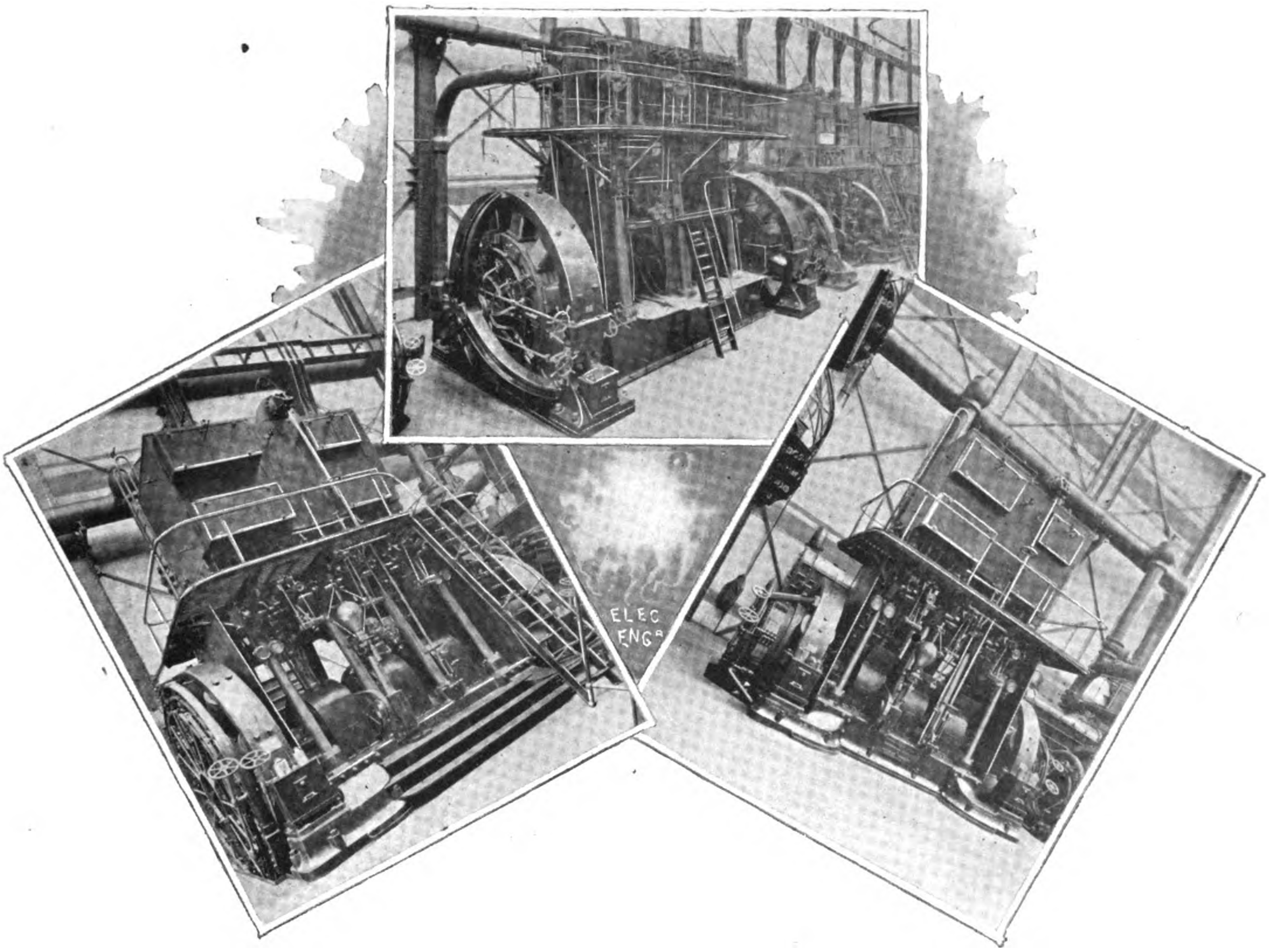
SOME DETAIL APPARATUS OF THE HARRISON STREET STATION, CHICAGO EDISON CO.

VIII.

The 400 K. W. dynamos operated in this station are the "smooth body" type of the General Electric Company. They have a cast steel frame upon which are mounted the 12 field magnets in multiple with each other, alternately positive and negative. The Gramme ring armatures have a cast iron spider wheel with double spokes carrying U-shaped copper bars of rectangular section insulated by mica. The current is taken off from the face of the armature by 36 brushes grouped in 12 sets of threes. The brush holders are connected by flexible flat bars to a pair of heavy copper bars arranged in a circle concentric and parallel with the engine shaft. To these bars are connected the dynamo cables running to the switchboard. The brush holders are carried on a circular iron frame, revolvable by a threaded rod and hand wheel, so as to change the commutation for different conditions of load. By means of another threaded rod and hand wheel, connected to a circular frame, the brush holder rods are rotated through an arc of a circle, and the brushes are thus all simultaneously placed on, or removed from, the commutator. The armatures are keyed directly to the engine shaft, and are operated at a speed of about 120 revolutions per minute, at which speed they develop a maximum E. M. F. of 155 volts, which may be reduced to 100 volts by means of the resistance box in series with the field magnet winding. These dynamos are capable of carrying a load of 3000 amperes for twenty-four hours, and may be depended upon to carry a load of 3,500 amperes for several hours without trouble. These 400 K. W. dynamos have no outboard bearing, and the armatures serve as the fly wheel for the engines. They are very compactly built, and are only 45 inches in depth, thus occupying very little space in the engine room.

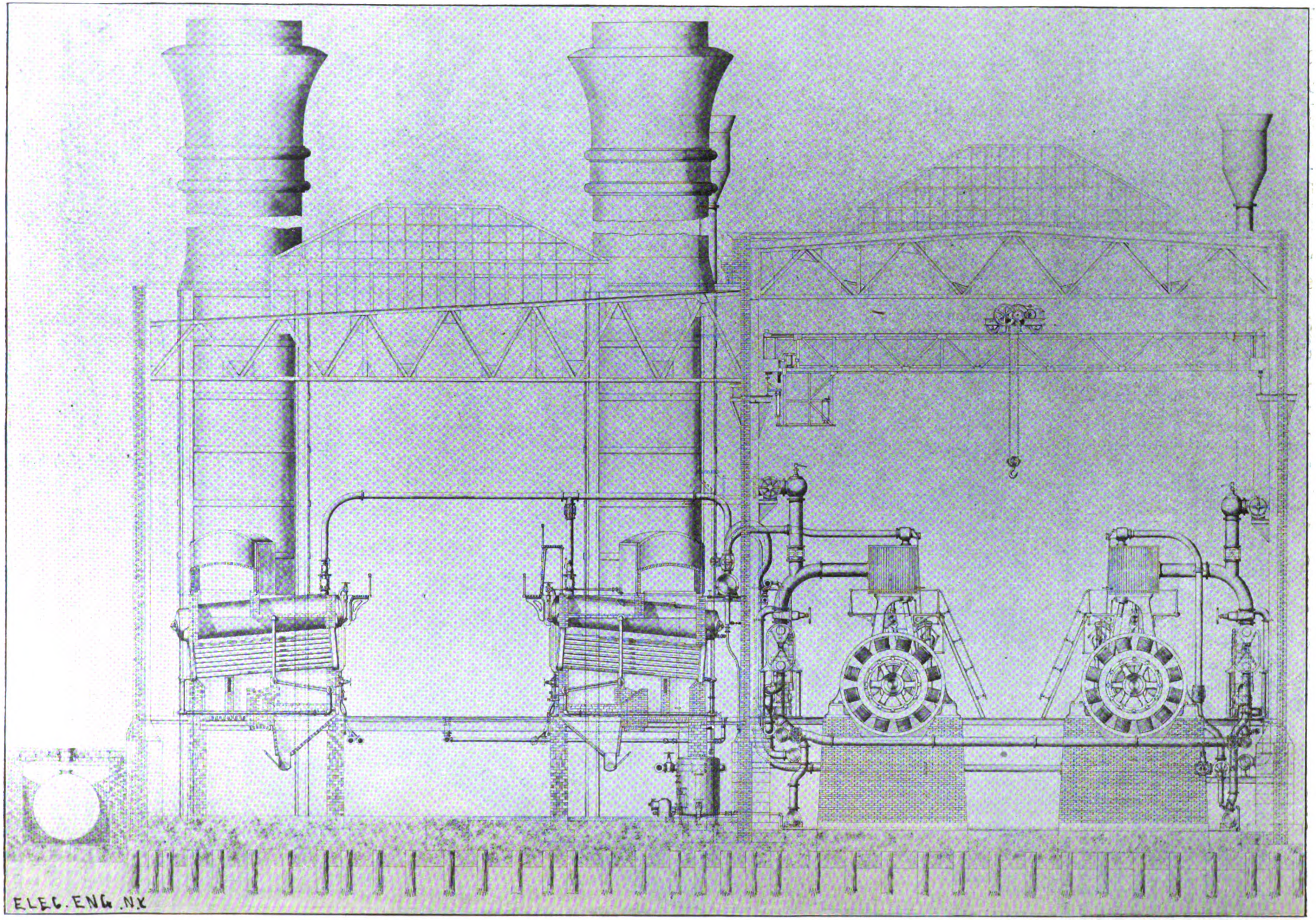
The 200 K. W. dynamos are of what is known as the "iron clad" type of the General Electric Co. The armatures are keyed directly to the engine shaft. The field magnet frame is of cast steel and carries the six field magnets, which are connected in series with each other, the magnets being alternately positive and negative. The armature cores are built up of thin sheets of iron punched out, with rectangular slots on their outer edge. The sheets are separated at four points in the length of the core, so as to admit air to the armature for ventilation. The armature conductors, which consist of rectangular bars, are placed in the slots of the core and insulated by mica. The armature conductors connect by specially formed bars to the commutator which is mounted on the shaft in the ordinary way. The current is taken from the commutator by 18 brushes arranged in 6 sets of 3 each and carried to the rings in the same manner as described for the 400 K. W. smooth body dynamos. The brush mechanisms are also the same. These machines have no outboard bearing. They are operated at 157 revolutions per minute, and develop 155 volts at that speed with an output of 1,500 amperes.

The station is operated on the Edison three wire system and each engine unit is a three wire unit by itself, i.e., on

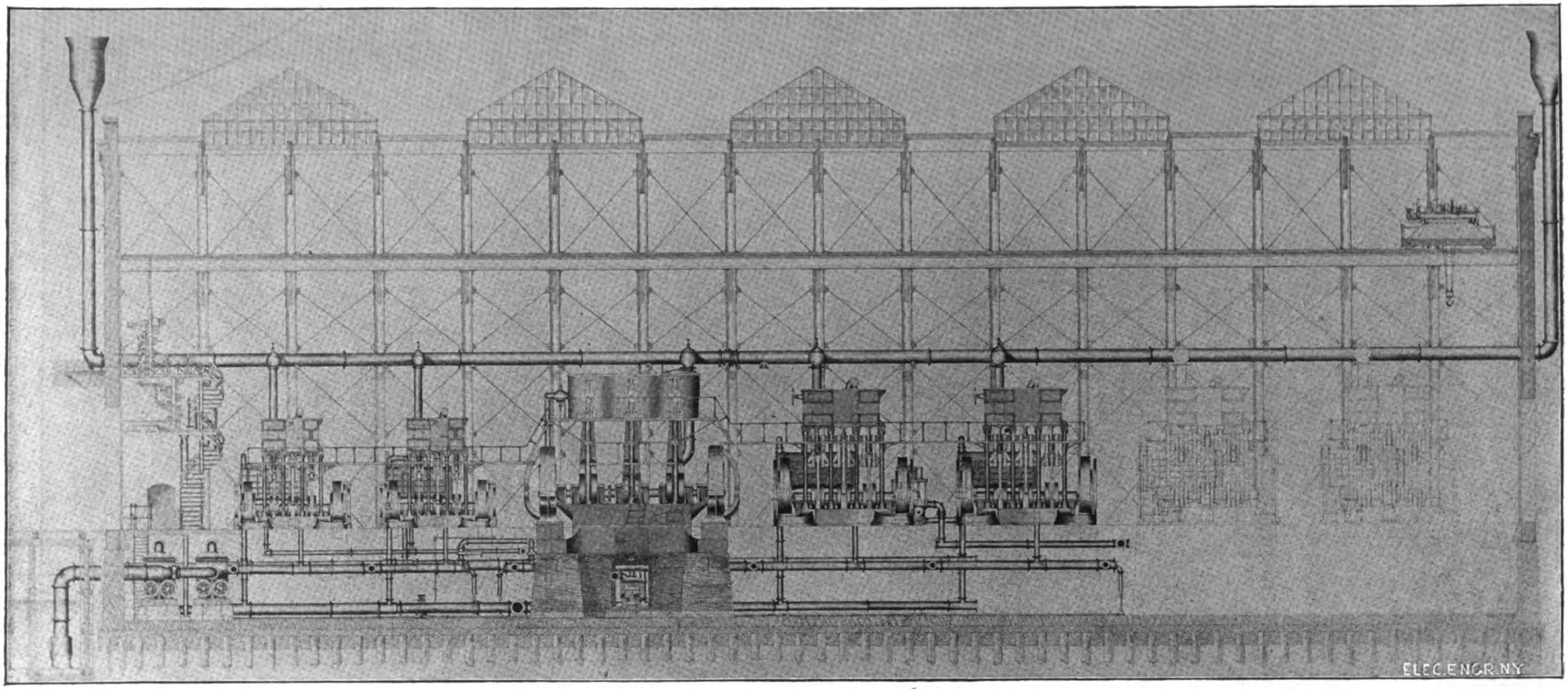


SOUTHWARK ENGINE. WORLD'S FAIR ENGINE. SOUTHWARK ENGINE.

THE THREE TYPES OF ENGINE, HARRISON STREET STATION.



SECTION OF HARRISON STREET STATION, THROUGH ENGINE AND BOILER ROOM.



each end of the engine shaft is connected a dynamo, the right hand dynamo being connected to the positive side of the system, and for simplicity sake called the "positive dynamo," the left hand dynamo being connected to the negative side of the system and called the "negative dynamo." The negative pole of the right hand dynamo and the positive pole of the left hand dynamo are connected together at the engine. From the positive terminal of the positive dynamo a cable of 1,500,000 circular mils, in the case of the 200 K.W., and a pair of cables, of 1,500,000 circular mils each in the case of the 400 K.W. is run to the switchboard and connects through a switch to the positive bus bar. Exactly the same conditions prevail on the negative side. From the junction of the negative pole of the positive dynamo, and the positive pole of the negative dynamo, a cable of the same size is run to the switchboard, and connects through a switch to the neutral bus bar. The cables are stranded copper, made up of 259

LONGITUDINAL SECTION

OF

DYNAMO ROOM,

HARRISON STREET STATION,

SHOWING TRIPLE EXPANSION ENGINES

DIRECTLY CONNECTED TO

WHEELER SURFACE CONDENSERS.

strands of No. 13 B. & S. wire, are wound with pure asbestos cord, and then covered with a light linen braid and painted with asbestos paint. They are supported, as shown, upon specially designed cast iron racks arranged to receive a rectangular porcelain insulator made in two parts, the cable resting within the insulator, the porcelain serving as the insulating medium of the cable. The arrangement is most economical of space and reduces possibility of fire to the absolute minimum.

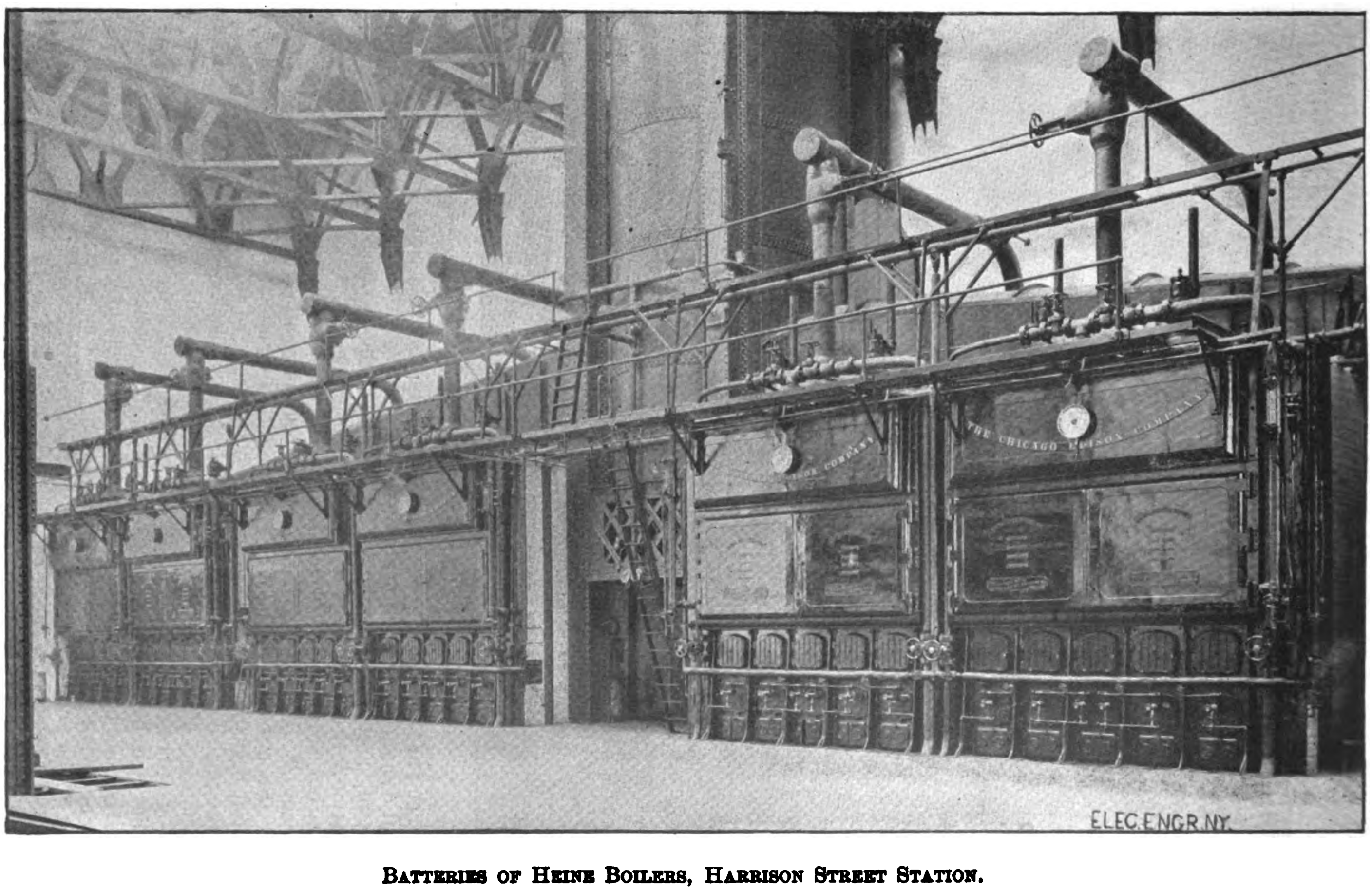
IX.

We have now reached the beautiful switchboard at the end of the engine and dynamo room, occupying a gallery about fifteen feet above the engine room floor, and rising in two tiers 16 or 18 feet more. It is built up of choice white Italian marble, supported by a framework of steel channel beams, and one of the most striking features about it is that, electrically speaking, it consists entirely of

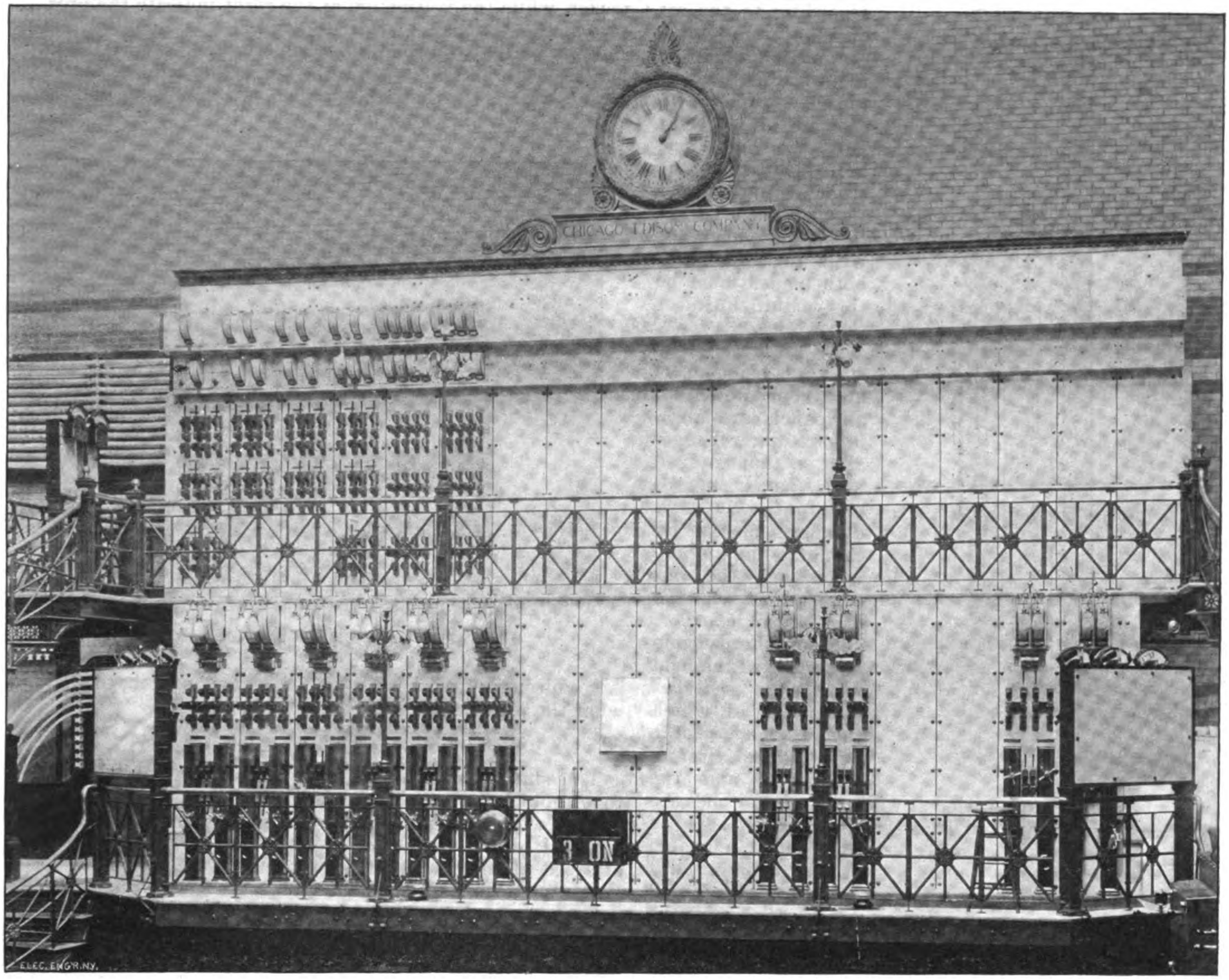
copper, not a bit of cast metal being used except where absolutely necessary. Remembering that copper costs about one-quarter as much as cast metal, for equal conductivity the great economy involved will be seen. Such a board must be expensive, anyhow, and one realizes that money has not been spared on essentials. It is, moreover, stately and handsome. It has bronze columns under the first gallery, which is reached by a light and graceful iron stairway, while another stair leads up to the second gallery. Along the gallery edges run wrought iron railings with an ornamental baluster of polished copper rod.

The capacity of the lower or regulating switchboard is 104,000 amperes while that of the upper or feeder board is 154,000 amperes and may be increased to 266,000 amperes by changing the switches and adding new bars to the bus. A 15 in. 41 lb. beam runs the full width of the station, its ends resting on beams in the main walls of the building, and supported also by four cast iron columns resting on independent footings. The floor beams of the first gallery are 7 in., 15 lbs., and are spaced 20 in. apart, and to them are fastened the cast iron upright brackets which serve at once as supports for the bus bars, and form a part of the skeleton iron work of the switchboard. The regulating switchboard is 8 ft. 1½ in. high and 8 ft. 6 in. from the East wall of the building. In front of the regulating switchboard the floor extends into the engine room for a distance of 6 feet, affording ample room for the operators. The second, or feeder gallery, is immediately above the regulating switchboard, the feeder switchboard being 5 feet from the East wall of the building, and the floor space in front of the feeder switchboard being 3 ft. 6 in. The switchboard is designed so as to be used ultimately as a two potential board, i. e., so that current may be transmitted from the switchboard at two different potentials. It is arranged, however, so that it may be used, if necessary, as a three potential switchboard, the 400 K. W. panels being connected for two potentials, and the 200 K. W. panels for three. On the back of the switchboard, three sets of positive and negative bus bars are provided, with a double neutral bus bar. These bus bars are called the "High Bus," "Low Bus," and "Medium Bus." The upper bus is high; the lower bus is low. Everything on the switchboard is arranged so that right hand and upper is positive, left hand and lower is negative, i. e., in every panel a right hand ampere meter, switch or galvanometer is positive, while the left hand is negative. In the feeder gallery all upper ampere meters and switches are positive, and all lower ones are negative. This rule is followed in the location of dynamos also. Any upward movement of a regulating switch or ampere meter means an increasing load while a downward movement means a decreasing load. This is done to avoid complication and errors on the part of the operators.

The regulating switchboard is divided into sixteen panels each twenty inches in width making the total length of the switchboard 26 feet 8 inches. Each panel of the regulating switchboard is devoted to one unit, consisting of a pair of dynamos either 400 K. W. or 200 K. W., as the case may be. At the top of each panel is a pair of Weston "edgewise" shunt permanent magnet ammeters with scale graduated either from zero to 2,000 or zero to 4,000 amperes. Each meter is illuminated by a 16 C. P. lamp on a polished brass bracket, and connected so as to act as a pilot light indicating to the operator when the dynamo is rising in electromotive force before it is put into circuit. These ammeters have needle points which move up and down in the arc of a vertical circle as the amperes increase or decrease. They are constructed on the shunt principle, but the scale is graduated so as to indicate the output of the dynamo in amperes at any time. Each ampere meter, whether for 2000 or 4000 amperes, is only four inches in width. The shunt, from which the ammeter receives its current, is a part of the dynamo lead, and con-



BATTERIES OF HEINE BOILERS, HARRISON STREET STATION.



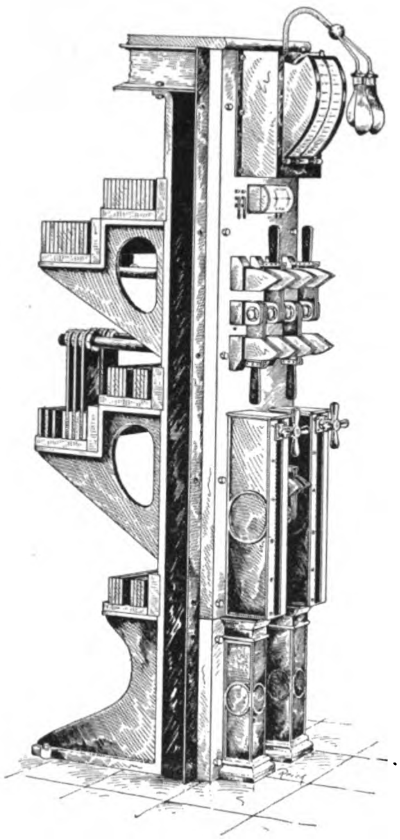
THE DOUBLE-DECK GALLERY SWITCHBOARD, HARRISON STREET STATION, CHICAGO.

sists of a pair of copper bars 4 in. x $\frac{1}{2}$ in., 56 in. long, in the case of the 4000 ampere instrument, and in the case of the 2000 ampere instrument, the shunt consists of a pair of copper bars 2 in. x $\frac{1}{2}$ in., 56 in. long. The ampere meters are connected to the bars at points 36 in. apart, the drop in pressure being approximately .02 volt. They can be read as far off as the centre of the engine house. They are mounted in iron cases, and finished in white enamel with polished copper trim.

Immediately below the ammeters are the dynamo galvanometers, one pair in one case. They are also constructed on the edgewise plan, the pointers moving up if the dynamo pressure is higher, and moving down if the dynamo pressure is lower than that of the bus bar. Each dynamo has its own separate galvanometer so that it is possible for any number of men to operate the switchboard, and any number of dynamos may be placed on the circuit at one time without affecting the pressure of the system and the candlepower of the lamps. This plan gives the operator no excuse for throwing the dynamos on the circuit and judging of the pressure by his eye. This method is too commonly employed and generally means a bad jump in the pressure-curve and complaints from customers. Each galvanometer is provided with a 3-throw switch, so that it may be connected at will to the high, low or medium pressure bus bars.

Below the galvanometers are the two dynamo switches, one for the positive dynamo, and one for the negative dynamo, so constructed that they may be used either as 2,000 ampere switches, for three potentials, or 4,000 ampere switches, for two potentials. Each switch is divided into two parts of 2,000 amperes each, and has three blades 3 in. by $\frac{5}{32}$ in. cross section, all connected in multiple, and making contact in four clips each 3 in. x 3 in. x $\frac{5}{32}$ in. The blades swivel in a central set of clips of the same dimensions, soldered into a base block of copper $4\frac{1}{4}$ in. x $1\frac{1}{4}$ in. From this base-block the current is carried to the ammeter shunt by means of three copper bars $2\frac{3}{4}$ in. x $\frac{1}{2}$ in., bolted to the shunt bars. The current is carried from the switch to the bus bars by means of two copper studs $1\frac{3}{4}$ in. diameter, threaded and soldered into the switch base block on one end. At the other end, also threaded are four copper nuts, two of which are $2\frac{1}{4}$ in. x $\frac{3}{4}$ in., and two $2\frac{1}{4}$ in. x $\frac{1}{2}$ in. These nuts fit the thread of the stud, and compress between their inner surfaces three sets of six sheets each of copper $2\frac{1}{4}$ in. wide x .045 in. in thickness. These sheets of copper fit between a pair of bus bars on the back of the board. All these switches, studs, nuts and laminations are made entirely of the best hard drawn copper, no part of them being of cast copper or cast composition metal. The contact surface in the switch clips is figured on a basis of 55 amperes per sq. in., the stud and nut connections on a basis of 100 amperes per sq. in. of contact surface.

The dynamos are put in circuit with the various busses



Detail of Switchboard.

according to the set of clips into which the switch blade is thrown. For instance, to put a 400 K. W. dynamo in circuit with the high bus, both blades must be thrown into the upper set of clips. To put the dynamo in circuit with the low bus, both blades must be thrown into the lower set of clips.

At present as the station is being operated on one potential, all panels are absolutely interchangeable, so that any 200 K. W. panel may be used for the 400 K. W. dynamos merely by changing the ampere meter and the bus connections on the back of the board.

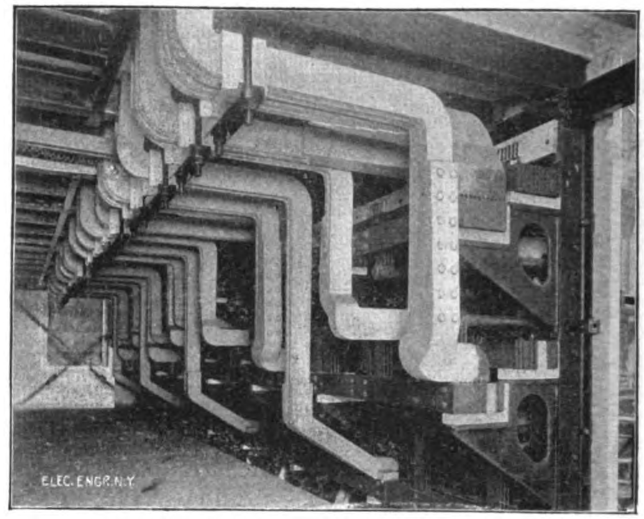
Below the dynamo switches are the field regulating switches by means of which the resistance of the field magnet circuits is varied, and the E. M. F. of the dynamo is varied at will. These switches are of the edgewise type, and consist of two parallel sets of clips (80 in each set) placed vertically with a movable copper double S brush contact. For the contact clips an 80-conductor cable passes downward through a small ornamental iron column to and under the floor of the regulating gallery, connecting to the regulator boxes which are suspended from the iron framework of the regulator gallery floor. These fireproof regulators are specially designed to fit the space and are 5 ft. x 8 in. x 16 in.

X.

Coming again to the back of the switchboard, we have the three sets of bus bars which are made up of one standard size of bar 4 in. x ½ in., placed on end. The feeder busses each consist of five bars throughout their entire length. At intervals of 40 in. the dynamo busses are connected to the feeder busses by means of copper bars passing through the floor vertically, distributing the current therein required and by this means the losses in the switchboard are very small indeed, since no large amount of current is required to travel through the busses any great distance.

The feeder board is divided into 18 panels, each 20 in. in width, containing ammeters and switches for four 1000 ampere feeders positive and negative. The four positive ammeters are at the extreme top and cover the full width of the panel. The four negative ammeters are directly below them. There is one row of positive, one row of negative, and one row of neutral switches, in the order named. The first four north panels are devoted entirely to the great Adams Street trunk line feeder,—of which more hereafter—having a cross sectional area of 42,000,000 circular mils, and a capacity of 42,000 amperes. The current density at this portion of the switchboard is 525 amperes per lineal inch or 6300 amperes per foot of board.

The voltmeter boards are located at either end of the regulator gallery. The voltmeters on the left end of the gallery indicate the pressure at the end of the standard feeder, while the voltmeters at the right indicate the pressure at the bus bars at Harrison and also at Adams Street stations, so that the operator or superintendent may tell at a glance the actual loss on the trunk line as well as the total loss of pressure on the system. In the feeder gallery

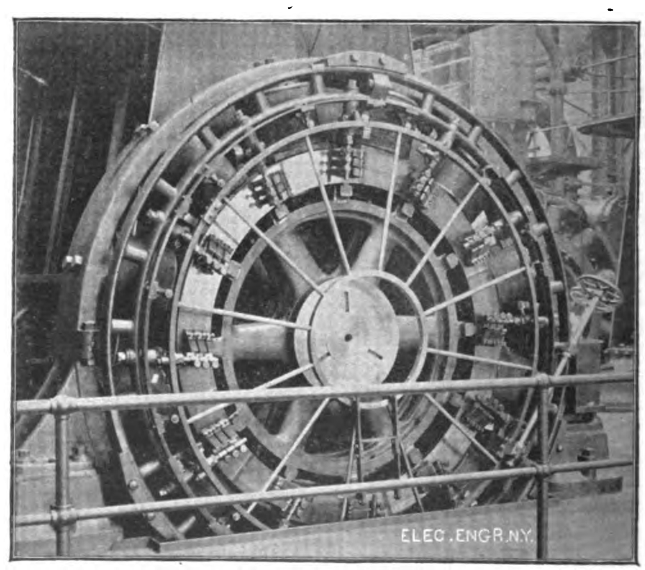


DETAIL OF BACK OF REGULATOR BOARD.

is a voltmeter board with an 80 contact switch, to show what the pressure is at the end of any feeder.

XI.

The station has now to deliver its current to the customer, but before we leave the station it may be well to sum up the impressions and conclusions derived from our visit. It would seem that approximate finality has been attained in this plant, for the units could not reasonably be larger, at this stage of the art, nor the steam production more economical, nor the apparatus for getting the generated current to the outgoing side of the switchboard more

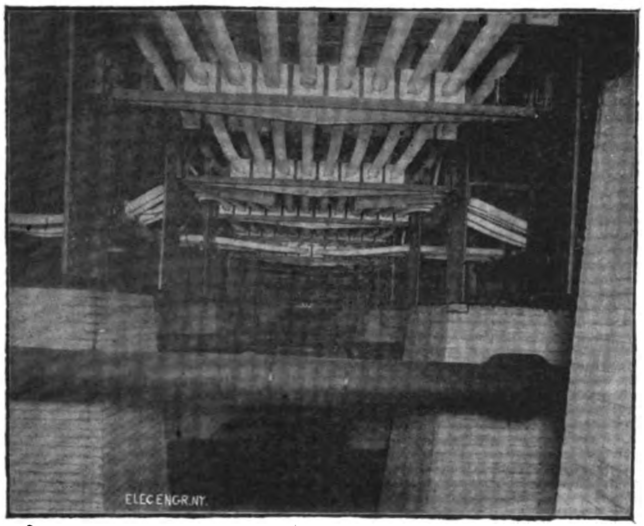


ONE OF THE 400 KILOWATT DYNAMOS.

perfect and efficient. Compared with the Adams street station, the results are at once obviously advantageous, and the writer hopes some day to be permitted to give the exact data shown by continuous operation.

The old Adams street station is situated at the very

heart of Chicago and hence has always been an admirable centre of distribution. It remains so to-day, for which reason the current from Harrison street is delivered to it just as goods are taken to a convenient entrepôt. For this purpose there is a trunk line feeder, known as the Adams



CONDUCTORS UNDER THE DYNAMO ROOM FLOOR.

street trunk line. It is 3,340 feet in length, carrying the entire output of the new station, and is the largest feeder that has ever been constructed. The positive and negative poles of this feeder are each of 21,000,000 circular mils, the neutral being 3,000,000. The switching arrangements are such, however, that in case the neutral feeder should burn out or be rendered useless, 3,000,000 circular mils of the positive or negative may be thrown in as neutral at a moment's notice. This feeder on leaving the Harrison Street station goes down a shaft 60 feet to the bed of the river, and thence through a brick tunnel under the river to the East side where it rises again in another shaft 60 feet into what is known as the feeder house where another small switchboard is located. These details are here illustrated. The feeder in the tunnel, which is 430 feet long, consists of 45 1,000,000 circular mils Siemens leaded, asphalted and iron armored submarine cable supported on iron racks. Where the cables hang 60 feet vertically in the shaft, the cable is supported by the iron armored sheathing clasped between iron plates on a heavy cast iron ring, the copper conductors thus hanging in a sort of basket, the strain being distributed throughout the length of the cable. At the feeder house the 45 Siemens cables connect with fifteen 3,000,000 circular mils Edison underground feeder tubes which continue uninterrupted to the Adams Street station. Manholes are built at intervals of 500 feet along the line, so as to afford a quicker means of locating trouble, should it ever occur on the trunk.

XII.

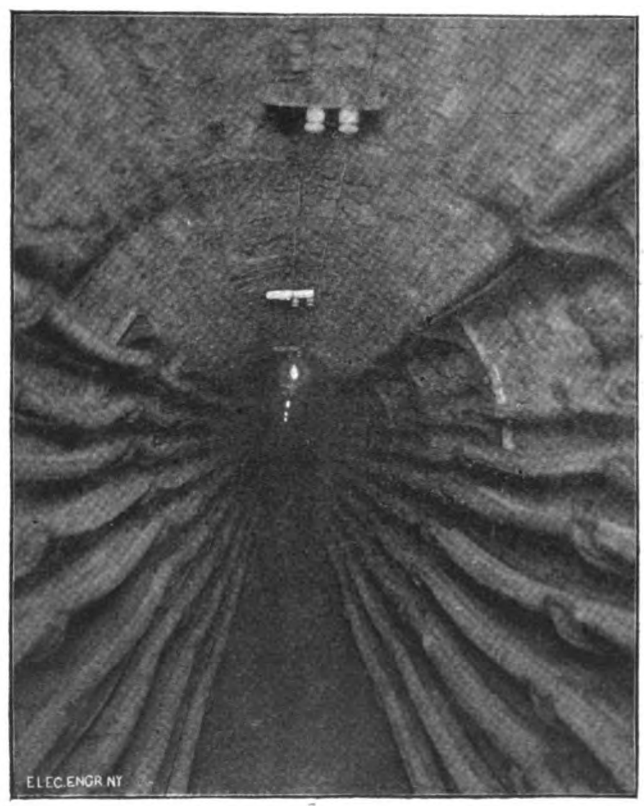
Arrived at Adams street the feeder tubes enter underground and connect to cables which run to a switchboard upon which are mounted fifteen 3,000 amp. switches, one for each tube. From this board 6 copper bars 4⅝ by ⅞ in. cross section rise to the second floor and join into the feeder board there, 3 of these bars being used for the positive and 3 for the negative side of the system. These bars are bound around with rope, painted with asphalt, and carried on a system of iron brackets mounted on marble bases, this in turn being fastened to the girders of the building.

It may be mentioned that over and beyond the networks shown in the maps, and the use of the two booster equipments, the company has plans for connecting up all the low tension mains and feeders of its Harrison street, Washington street and Wabash avenue stations, making an immense network of conductors fed into by the three plants on a predetermined allotment of work to each. This again is destined to include at no distant date the network of the North side; and when this is done the entire low pressure system of the company for a distance of six miles will be merged. This system has the preference of the company over that of "tie lines" between the stations themselves, and will doubtless stand until new needs bring further evolutions of practice.

XIII.

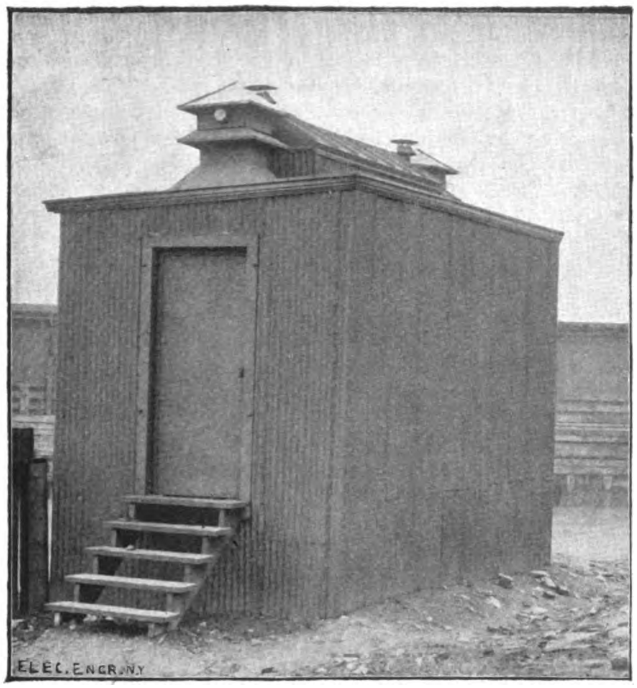
The low tension 99 miles of tubing or 297 conductor miles, do not by any means complete the underground system of the Chicago Edison Company. For alternating and arc work, there are 21¼ miles of conduit or pipe, and 11 miles of power circuit, comprising 167 miles of duct, but not inclusive of the long new line of 11,000 feet of National conduit cement lined pipe for Milwaukee avenue. In all this conduit and in service work, about 400 miles of cable all told are in use. During the last three or four years, the Company have employed a large quantity of Norwich paper cable for high tension work, as well as low, and speak very highly of its performance. The service work of the Edison tubes in the residence districts is done chiefly with Habirshaw and General Electric 3-wire cable, but everything under the pavement is tube. The alternating leads are carried in 3-inch pump log, and the existing arc distribution is of the same class. The Dorsett conduit system laid as far back as 1883 remains in use, and is owned by the Chicago Sectional Underground Co., to which the Edison Company pays rental.

The Company's rates for current and service may be



CHICAGO EDISON TUNNEL UNDER THE CHICAGO RIVER.

stated broadly as follows: Arcs, 7 cents per hour for a 10 amp. series arc lamp, but there are several hundred meter 6 amp. and 10 amp. arcs on the incandescent circuits. Motor work, 10 cents per 1000 watt hours, on the 500 volt circuit. Incandescent, 1 cent per 16 C. P. lamp hour. All

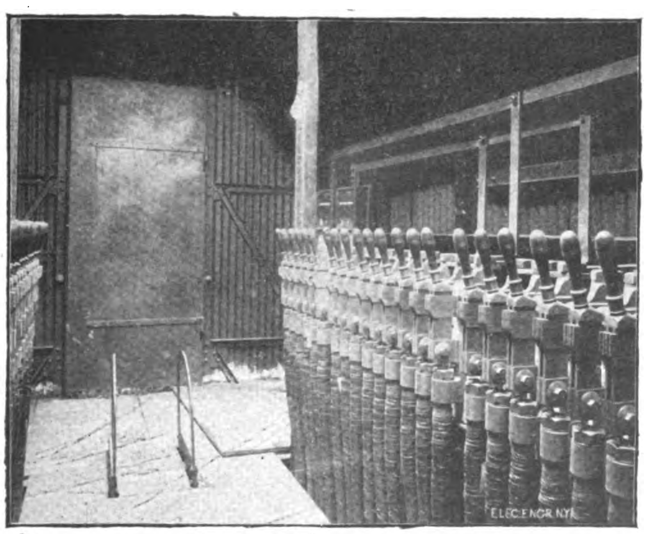


CABLE HUT, EAST SIDE OF RIVER, FACING HARRISON STREET STATION.

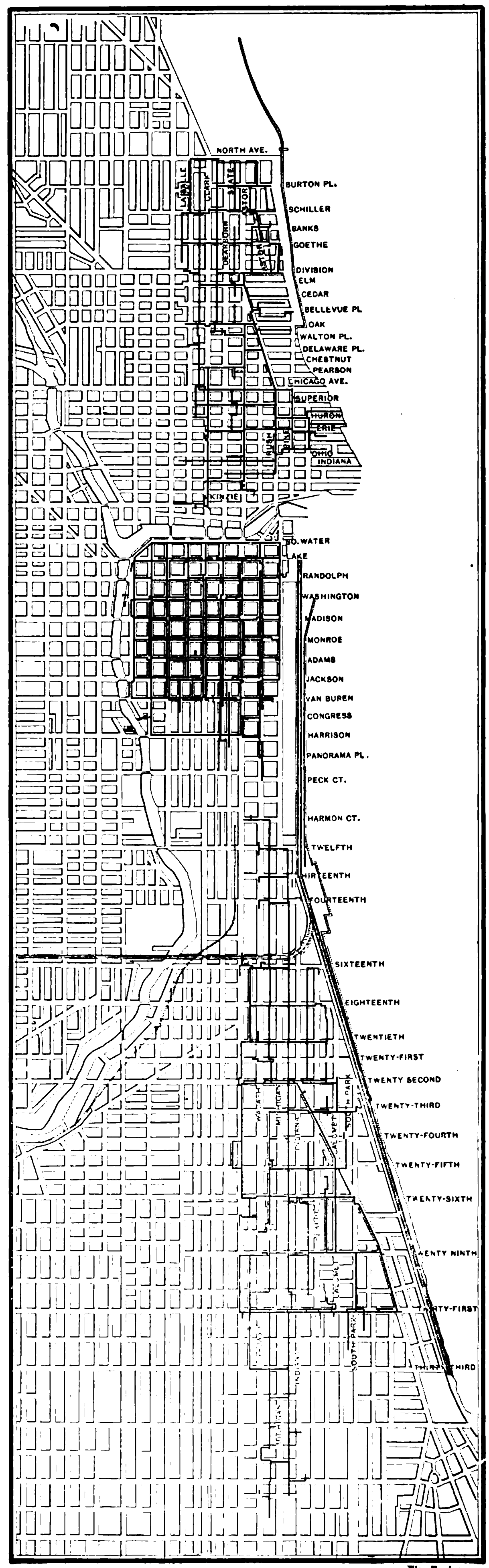
these rates are subject to discounts according to the amount of current consumed. About 12 per cent. of the work is in residence lighting, and the Company is daily devoting more of its energies to this field. Below is an interesting six years' record of the Company's growth :—

	Incandescent Lamps connected.	H. P. in Motors.	Series Arcs. Contract.	Low Tension Arcs. Meter.	Equivalent in 16 c. p.
1889	17812	234			21556
1890	29139	925			43939
1891	53135	1258		486	78609
1892	88259	1826	2320	1095	155040
1893	187401	3616	2512	1613	240634
1894	161927	4210	1917	1707	269151

It is curious to note that the motor capacity is as high as 40 per cent. of the incandescent light capacity, and presumably is in service many more hours in a day. The Company by its excellent service has made it worth the



INTERIOR OF CABLE HUT, SHOWING TERMINALS.



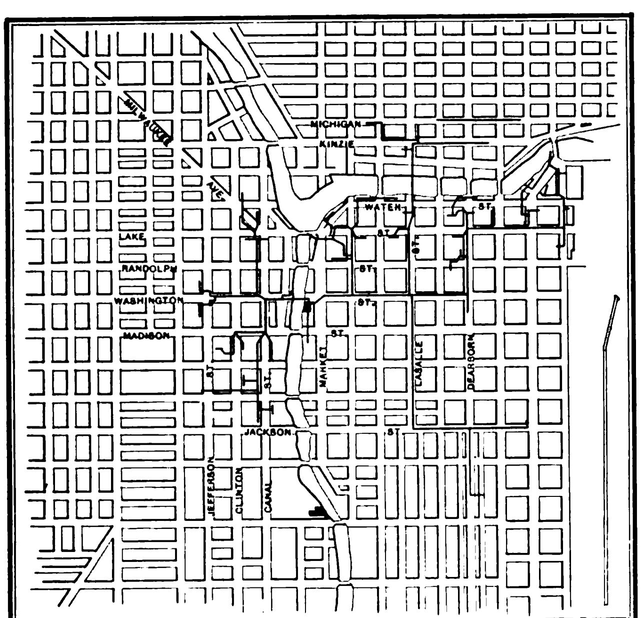
MAP SHOWING THE CHICAGO EDISON LOW TENSION DISTRIBUTION.

while of many large buildings to receive current from it in place of running their own plants. Among its patrons may be named the Monadnock Building, 8,000 lights; Marquette, 5,500; Old Colony, 5,500; Great Northern Hotel, 6,500; Tacoma, 2,000; Title & Trust, 3,500; Y. M. C. A., 2,500; Hotel Metropôle, 2,700; Champlain, 2,000. The Schiller Theatre building with 4,000 lights is furnished with current at certain stipulated times, and a special arrangement for current exists also with the Chicago Athletic Club, with a plant of 2,400 lights. A great deal of large power work is done likewise, and one motor of no less than 110 H. P. is employed in the coffee roasting factory of Chase & Sanborn. The Chicago *Tribune* takes 65 H. P. for some of its presses, the *Interocean*, 77 H. P.; the *Herald* and *Post* have presses run occasionally to the extent of 40 H. P. and take 1,400 lights as well. Thus it goes all along the line, and every new enterprise of any pith and moment now looks to the Chicago Edison Co. for some or all of its supplies of light, heat and power.

XIV.

The various aspects under which the history and growth of the Chicago Edison Company have been studied lead up to the executive. Its officers are: President, Samuel Insull; Vice-President, J. W. Doane; Secretary and Treasurer, F. S. Gorton; Comptroller, W. M. Anthony; General Superintendent, C. H. Wilmerding; Electrical Engineer, L. A. Ferguson; Purchasing Agent, Chas. Holmes; Sup't of Low Tension System, W. L. Church; Sup't of High Tension System, R. S. Kelsch.

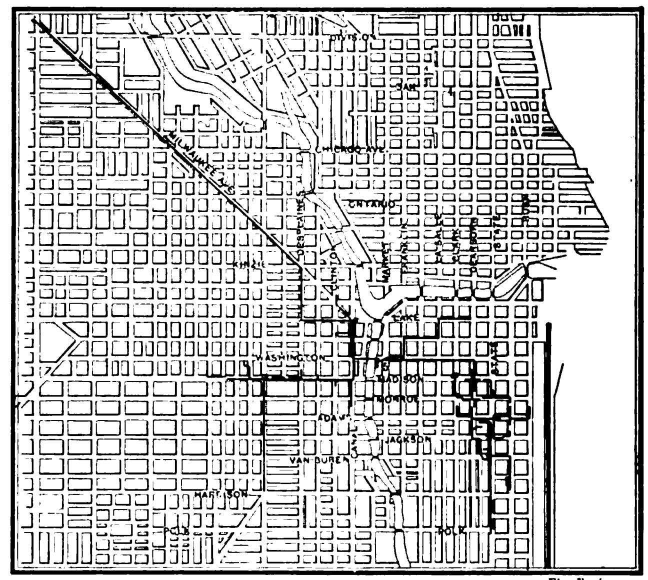
It would not be right to close this descriptive sketch, which leaves a great deal that is interesting unsaid, long though it may be, without a deserved compliment to Mr. Fred Sargent, the Supervising Engineer of the Company, on the noble piece of work with which his name is associated at Harrison street. His long previous experience in central station design and construction, enriched by observations of work on an unprecedented scale carried through by him as mechanical engineer of the World's Fair, was brought to bear upon this plant



SPECIAL CIRCUIT OF 500 VOLT POWER DISTRIBUTION, CHICAGO EDISON CO.

and shows itself in so many points of skillful refinement and adjustment of conditions that a volume would not suffice for them all. Praise is also due Mr. A. B. Herrick for his designing upon the great switchboard. Mr. Ferguson had charge of its erection, was also the sole designer of the rest of the electrical work in the station and had full charge of the electrical equipping there. Messrs. Shepley, Rutan and Coolidge were the architects of the station, and Leach & Son were its builders.

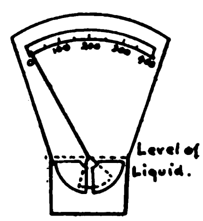
The writer wishes further to record his deep sense of



REGION COVERED BY ALTERNATING CIRCUITS, CHICAGO EDISON CO.

the kindness and courtesy of Mr. Insull in granting an opportunity to inspect closely all the work of the Company, and to Messrs. Anthony, Wilmerding and Ferguson for the copious data placed at his disposal about every point on which information was sought.

THE ROWLAND IMMERSED ELECTROSTATIC VOLTMETER.



To the description of the elecrostatic voltmeter designed by Prof. Henry A. Rowland, and published in our last issue, we are enabled to add some interesting additional information since communicated to us by Prof. Rowland.

The electrostatic voltmeter immersed in a fluid has been carefully tried by Prof. Rowland who finds it to work admirably, a rough one having been in use in his laboratory for over a year. The great electrostatic force which is developed, together with the perfect damping, make it a very practical instrument adapted to rough usage. The form which Prof. Rowland finds best is that shown in the accompanying engraving where only the quadrants are immersed and the pointer is free in the air. The liquid then comes up only to the axis of suspension.

In one case, in using 1,000 volts on the voltmeter, a contact occurred under the liquid. The liquid was not disturbed in the slightest degree, but about a yard of connecting wire outside the instrument was deflagrated with a loud report. The instrument itself was not injured in any manner. Had it been in the air it would have been destroyed.

The constant of the instrument remains unaltered with time, provided the same fluid be used. Fluids can now be obtained with specific inductive capacities up to 30 or more, but they are generally poor insulators and have some defect. In ordinary oil the spaces can be so much smaller than in air that the forces are immensely greater while good insulation is maintained. The instrument can be made very large and makes a first-class engine room indicator.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIX. NEW YORK, JANUARY 23, 1895. No. 351.

CONTENTS.

FEATURES OF THE BROOKLYN TROLLEY STRIKE.

A PORTION of New York City—Brooklyn—has been undergoing for a week past the discomforts that must inevitably attend a cessation of traveling facilities in the middle of winter. Probably 250,000 citizens of Brooklyn cross the East River every day to work, and of that number a large proportion has to depend upon the trolley cars for its means of getting to-and-fro. The strike of the motormen on the Brooklyn trolley roads has deprived many persons of the opportunity to ride and has thrown others upon the service of the elevated system, which has been correspondingly crowded.

The right of either the men or the companies, by suspending work, to deprive the public of these necessary means of locomotion is not very clearly established, but there can be no question that so long as it is operating within the privileges of specific laws and franchises, a company has the right to the management of its own property under protection of the civic power, and, in the last resort, under the protection of the military. The fact that a street car carrying United States mail should be regarded as sacred and is "put through" a road despite of any or all opposition is one with which we find no fault; but it is difficult to understand at what point a man's letters become more worthy of lawful protection from injury and wrong than the man himself, traveling over the same road.

The disputes between the Company and the men touch various items. We can sympathize with the men in their desire to get more pay, but the rush to fill their positions by those who in these hard times are without work, shows that the wages bear some relation that is reasonable to the laws of supply and demand. As to the contention of the men that the companies shall, virtually, not employ "trippers," i. e., men put on in emergencies to run relief cars during busy hours, that is simply absurd. We all do just this in our homes, offices and factories. The washerwoman, charwoman, dressmaker or bootblack is nothing more nor less than a "tripper" in the sense of performing some extra, irregular but necessary duty that the ordinary staff or one's self is not equal to. The young ladies who stenograph and typewrite might as well insist that no such work shall be sent out of the offices they are employed in, when there happens to be, as often there is, a rush of letter writing or copying that swamps the force.

In this great and avoidable struggle, the street car companies of Brooklyn, which have "been there before," enjoy the advantage of not having to feed a lot of idle horses. The machinery lies practically still and dead. Of course there is the loss of fares, amounting to over $15,000 per day, but the men inflict on themselves a loss of at least $5,500 daily and deprive other associate workers of not less than $1,500, unless the companies choose to continue such men on the pay rolls. The Brooklyn City, Atlantic Avenue, Broadway and Newtown companies operate altogether about 1,000 trolley cars. If we allow an average of 8 or 10 horses, a usual number to the ordinary city street car, it will be seen that these companies are gainers to some extent by not having the feed and care for nothing, of 8,000 idle horses. On the other hand they have heavier interest charges going on due to the heavier investment in a costly plant, so that they have strong temptations to meet the men on any fair basis of agreement. We trust that such a basis may soon be found.

It is a curious feature of the situation that opposed as it was with virulent opposition at the outset, the trolley has made itself a welcome necessity in Brooklyn, and its withdrawal from the field through the strike is felt to be a most serious deprivation. It may be deadly, but all that Brooklyn cares about, and particularly the feminine, shopping portion of it, is to know how soon the killing is to begin again, as they propose to take immediate advantage of the restored opportunity. Perhaps with the service restored, some of our Brooklyn friends will not be quite so eager to have the cars run at a snail's pace, but will rejoice in their speedy trips from suburb to centre.

AN IMPORTANT CENTRAL STATION AND ITS LESSONS.

The criticisms which have been made in the past, more especially by foreigners, on the general character of the engineering displayed in American electric central stations have been, it must be confessed, for the larger part deserved. But while admitting this we must not lose sight of the fact that our central station work was begun when the lines of development could hardly have been foreseen, and were not even dimly outlined on the horizon. Our foreign friends were the first to profit by American mistakes, while the heavy cost of changing over old types of machinery and antiquated methods of construction has heretofore deterred home companies from adopting those plans which have since been shown to be productive of the most economical results. But whatever the mistakes may have been, we believe that no fair minded observer abroad will lay at our door the charge that we have not ourselves profited by them, or deny that American central station construction of the last few years compares favorably with that of any other country. We believe this not only of solid electric railway work, examples of which can be pointed out by the dozen, but also of brilliant successes in electric lighting; and as the most recent and perfect exemplar of the latter class, we present in this issue a description of the splendid new Harrison Street Station of the Chicago Edison Company. We have devoted more than the usual amount of space to a careful description of the whole work of this company, as it presents in many respects a typical case of steady growth, and the outcome of intelligent study of the problem of current distribution within cities. After all, cheap current pro duction depends upon cheap steam production and this aim was had in view constantly in the work at Chicago. But it will also be noticed that in addition to the steam economies attention has been paid particularly to the electrical economies in the station, as exhibited in the liberal use of copper in bus bars and in the switchboard apparatus. This is a point which seems thus far to have been generally neglected in central station practice, but which has been remarkably well pointed out by Mr. Edward Weston, who has shown that the loss in the conductors, bad joints, etc., in central stations may amount to the interest on a large capital investment.

With the fuel, steam and current economy brought to the lowest possible limit, along standard lines, what, it may be asked, is the next great desideratum in light distributing economy? It must be, evidently, a still further reduction in the price of the incandescent lamp. Much has already been done in this direction, but we are certain that the limit has not yet been reached. The great impetus which has been given to incandescent lighting within the last few years may, we think, be directly traced to the reduction in the price of lamps, and with a still further cheapening of this important factor, the field for incandescent lighting, both from central stations and private plants, will be enlarged almost in direct ratio to the reduction. The same conditions apply, to some extent, to arc lighting, the low price at which arc lamps can now be obtained and the steady reduction in the price of carbons, having given the arc lamp, which some years ago was supposed to have reached the limit of its applications, a most pronounced onward movement. In examining the work of the Chicago Edison Company, one cannot but be struck with the figures showing the ratio of the current applied to lighting and to power. These indicate that no less than 40 per cent. of the total output of the Chicago Company is devoted to the driving of motors, by no means confined to the fan or smaller sizes, but running up to 50 or 60 horse power, and in one case, even to 110 horse power. This is a most significant showing and is an indication of the direction in which electric lighting companies may still work for the utilization of all their resources. In addition to the small cost of attendance entailed in power distribution, it presents the great economical advantage from the station standpoint, of maintaining the day load at a level which makes it economical to run large units, and to avoid the precipitous peaks, which have proved the insurmountable obstacle to the declaring of dividends in more than one central station. The new Chicago Edison station is an object lesson which will not be lost on central station designers and it speaks well for the enterprise and ability of those who have made it a possibility and an actuality. There is but one other lesson on which emphasis will be put at this moment, and it is that it has been found altogether wise and economical to put so large an investment into direct current low tension work. One cannot, however, gainsay the results. Should the various networks of the Company be merged as indicated in the article, we fancy that in so large an area as one 6 miles long by 3 or 4 wide, economical use will be found for rotary transformers; but it is said that the Company is working on too large a scale to render storage batteries a needed feature of the equipment, although their use has been found so desirable abroad and so successful in Boston and in New York. As in some other instances, Chicago appears to present the problems in a manner special to itself, to be dealt with in special ways.

THOMSON-HOUSTON REGULATOR PATENT HELD INVALID.

Elsewhere in this issue we print the substance of Judge Grosscup's opinion dismissing the bill of the Thomson-Houston Electric Co. against the Western Electric Co. for infringement of the Thomson-Houston dynamo regulator patent of 1881, and give also a brief history of the litigation.

The main point of the defense was that the invention claimed was anticipated by the patent to the same inventors of 1880. While Judge Grosscup does not cite the case of Miller *vs.* Eagle Mfg. Co. he evidently deems the doctrine therein announced by the Supreme Court applicable to the regulator case, viz.: that a patent claiming additional or different functions for devices shown in an earlier patent to the same inventor is invalid. [See THE ELECTRICAL ENGINEER, February 7, 1894.] Our readers will remember that the Miller *vs.* Eagle decision was Judge Carpenter's chief ground for invalidating the Berliner telephone patent. Judge Grosscup deals also with that difficult question:—where is the border line between invention and mechanical or engineering skill? While recognizing the difference in function of practically the same devices shown in the earlier and later Thomson-Houston patents, the Court evidently deems the information conveyed by the patent of 1880 sufficient to enable a skilled electrician to achieve the results sought to be monopolized in the patent of 1881. There is, perhaps, some obscurity in the following passage of the opinion:

> If there is any mistake in this judgment it is, I think, in putting a higher estimate upon mechanical skill in electrical fields than is applied to other fields, but I do not see how this can or ought to be avoided. It necessarily requires high skill to be an electrical mechanic at all. Adjustments and adaptations are there every day made use of. To give to each of these the dignity and consequence of inventions would tie up permanently this whole useful field to monoply.

That is: to be "skilled in the art" of electricity involves a higher degree of ability than in ordinary mechanical occupations—and that therefore it is reasonable to suppose that a well qualified electrical engineer would find no difficulty, with the knowledge at hand in 1881, in devising an automatic regulator dependant for its action upon the variation of current in the external circuit.

In view of the far-reaching scope of the patent it is not too much to say that the Western Electric Company deserves the thanks of all manufacturers and others concerned with arc lighting for their persistent contention of the case. The case will be appealed.

THIRD ANNUAL CONVENTION OF THE NORTHWESTERN ELECTRICAL ASSOCIATION, MILWAUKEE, JAN. 16, 17 AND 18.

The Third Annual Convention of the Northwestern Electrical Association was called to order at 11 a. m. Jan. 16, by PRES. C. C. PAIGE, in the Club Room of the Hotel Pfister, Milwaukee. The attendance was good, nearly every member being present, who, together with other visitors interested, helped to make the convention a great success in every way.

THE ATTENDANCE.

The following members and guests were in attendance:

CHICAGO, ILL.—M. B. Austin, J. R. Allen, A. C. Bunce, Loren W. Burch, F. J. Baker, Geo. Cutter, J. H. Cooke, Fred De Land, Chas. Forbrick, C. E. Gregory, W. S. Hine, C. Kammeyer, W. W. Low, H. D. Latimer, John R. Markle, S. F. B. Morse, John C. McMynn, Frank L. Perry, W. A. Remington, M. J. Sullivan, J. S. Stephens, J. Stedman, Geo. Whyte, and Jas. Wolff.

MILWAUKEE, WIS.—Herman Andrae, S. G. Coleman, Lucius T. Gibbs, Wm. Goltz, J. C. Koch, E. G. Mullen, T. R. Mercein, and O. M. Rau.

W. B. Baker, Waupaca, Wis.; Chas. Cuno, Oconomowoc, Wis.; G. L. Cole, Beloit, Wis.; E. L. Debell, Sheboygan, Wis.; Geo. A. Davis, Neenah, Wis.; Edw. Engebretsen, Whitewater, Wis.; Geo. A. Farwell, Waukesha, Wis.; W. P. Fitch, Mason City, Ia.; C. B. Fairchild, New York; Geo. Grim, Jefferson, Wis.; H. H. Hayden, Eau Claire, Wis.; J. H. Harding, La Porte, Ind.; J. M. Hill, St. Louis, Mo.; P. H. Korst, Racine, Wis.; I. P. Lord, Waupaca, Wis.; M. Nippert, Lake Geneva, Wis.; Pliny Norcross, Janesville, Wis.; C. C. Paige, Oshkosh, Wis.; J. A. Pamperin, Oconto, Wis; G. H. Rodman, Ravenna, O.; John Schuette Manitowoc, Wis.; M. L. Stevenson, Cleveland, Ohio; W. H. Thorp, Beaver Dam, Wis.; H. C. Thom, Madison, Wis.; J. F. Wiley, Stevens Point, Wis.; C. D. Wilkinson, New York.

FIRST DAY, MORNING SESSION, JAN. 16.

The roll call and reading of minutes were on motion of Mr. Cole deferred until the second day.

The address of the president was then read by Secretary Thom and received with vigorous applause.

PRESIDENT'S ADDRESS.

PRESIDENT PAIGE, in his address, made a vigorous protest against governmental ownership of railroads, telegraphic, electric and other public service. He said there were over $200,000,000 invested in electric lighting and power plants in the United States, every dollar of which should have the regard of every honest man and every honest government. There was an unholy, infamous, and communistic warfare being waged on these enterprises, which was antagonistic to the principles of our institutions. He advised the members of the convention to organize against the foe. The municipal ownership of electric lighting plants, he said, seemed to be the foremost of all other public service in securing advocates. It was the watchword of all enthusiastic aldermen and ward steerers seeking places upon the city's pay-rolls. These people paid little if any taxes, but were the loudest in their lamentation. There were also manufacturers of electrical appliances who were allied with them, who were telling how the people were being robbed by the old companies, because they anticipated that it would be more profitable to sell their goods to a municipality than to a corporation or company run on business principles.

AFTERNOON SESSION.

The afternoon session was called to order at 2.30 P. M. Pres. Paige in the chair.

MR. PLINY NORCROSS read his paper on, "Hints on Daily Work about a Dynamo Room." The paper met with close attention by the audience and was greeted with spontaneous applause at its close. The paper was extremely interesting, giving as it did, the experience of ten years in the operation of a lighting plant. It was full of excellent hints and suggestions, Mr. Norcross laying particular stress upon the advantage of modern, slow speed generators and the importance and truth of the maxim that "there is nothing too good for the electrical business." He believed that the day of high speed electrical machinery is fast drawing to a close. The author had so thoroughly covered the ground that, when discussion was invited few members had anything to say, the universal sentiment seeming to be that Mr. Norcross' statements were only too true.

MR. CHAS. G. BURTON of the Central Electric Co., then read his paper on "Interior Conduit and Interior Wiring."

This was probably the most interesting feature of the day's meeting, to judge from the animated and extensive discussion it brought out. The discussion was started by Mr. I. P. Lord, of Waupaka, by the statement that during the last nine years not a single accident had occurred in his city in spite of the fact that not a foot of conduit was in use. The discussion, which was, to say the least, a lively one, was participated in by Messrs. Davis, Schuette, Burton, Norcross, Thom, Cutter, Gage, Debell, Low, Wood, Markle, Pierce, Grimm, Grover and others.

THE SECRETARY then read an invitation from Messrs. S. F. B. Morse & Co., inviting all present to attend an exhibition of artistic club swinging by Mr. G. W. Patterson of Chicago, to take place in the firm's parlors at the close of each session. The meeting then adjourned till 8 P. M.

EVENING SESSION.

The meeting was called to order at 8.15 P. M. with Vice-Pres. Debell in the chair.

A paper by Mr. Wm. Goltz was read entitled "Incandescent Lamps vs. Welsbach Burners."

The author called attention to the danger which threatened the successful introduction of electric lighting by the Welsbach burner and pointed out some of the defects of the latter, indicating the lines on which it should be fought. He claimed that the Welsbach burner was more than a passing "fad," and that its danger must not be underestimated. The paper was received with marked applause and a most interesting discussion followed, participated in by Messrs. Highlands, De Land, Farwell, Schuette, Lord, Thorp, Thom, Debell, Wiley, Harding, Grimm, Markle and others. On account of the lateness of the hour, the very interesting discussion had to be cut short and the paper by MR. JNO. R. MARKLE on "Some Characteristics and Economics of Accumulators, as Applied to Central Lighting and Power Stations" was read by the author, the intention being to take up further discussion of Mr. Goltz's paper in connection with that of Mr. Markle.

The latter paper, in a concise manner called attention to the advantages of accumulators as an adjunct to lighting and power stations and received well merited applause, after which the discussion of the two papers was proceeded with, Messrs. Grimm, Farwell, Norcross, Thom, Hine, Markle, Grover, Debell, Harding, Davis and Terry being the principal participants.

On motion of Sec'y. Thom a committee of three on resolutions was appointed, the chair naming Messrs. GRIMM, NORCROSS and DE LAND as members of the committee.

Adjourned till 10 A. M. of the following day.

SECOND DAY, THURSDAY, JAN. 17.

Called to order 11 a. m. PRESIDENT PAIGE in the chair. The Reports of Committees were first taken up, all reports being accepted, one committee (on schedule of rates) asking for further time.

A Committe on "Underwriters" was appointed by the Chair, consisting of Messrs. Norcross, Grimm and Copeland.

The election of officers was next in order, and the following were elected for the ensuing year:

Prest., H. C. THOM, Madison, Wis.
1st Vice Pres., GEO. GRIMM, Jefferson, Ind.
2d Vice Pres., PLINY NORCROSS, Janesville, Wis.
Sec'y, WM. GOLTZ, Wilwaukee, Wis.
Treas., JNO. SCHUETTE, Manitowoc, Wis.
Board of Directors: F. S. COPELAND, LaCrosse, O. M. RAU, Milwaukee and E. M. HIGHLAND, Clinton, Ia.

The treasurer's report was read showing receipts during the past year of $742.35 and expenditures of $753.46, making a deficit of $11.01. Report adopted.

A spirited discussion next arose over the selection of a meeting place for the coming summer meeting, Chicago being finally chosen in spite of rather strong opposition from some members.

A resolution offered by MR. M. J. SULLIVAN that the name of the association be changed so as to read "Western Electrical Association" met with unqualified opposition, the universal sentiment of those present being seemingly in favor of confining the membership and workings of the association to Wisconsin and immediately adjoining states.

A paper by Mr. G. L. COLE entitled "Incandescent Lighting on the Meter System Compared with Contract System" was next read by the author, who strongly advocated selling light on what he aptly termed the European system, i. e. "Pay for what you get;" the American idea seeming to be "Contract by the year and take all you can get." The author pointed out the numerous advantages of the meter system. An interesting discussion was participated in by Messrs. Norcross, Davis, Thorpe, Lord, Schuette and Copeland.

A Paper by Mr. T. R. MERCEIN was read next on "Auxiliary Adjuncts to Electricity" in which the author explained the advantages of the "Auxiliary" Gamewell fire alarm system.

The following new members were then elected: Chas. G. Burton, Chicago, George S. McLaren, C. D. Wyman, John D. McLeod, Milwaukee; H. C. Higgins, Marinette; A. A. Forman, Iron Mountain, Mich.; C. D. Wilkinson, Chicago; W. F. Collins, Wausau; Willis D. Jameson, Chicago; J. W. White, Peoria; Richard A. Dix, Wauwatosa; E. P. Ingham, Fargo; Fort Atkinson Lighting Company, Fort Atkinson; James Montgomery, Wausau; J. E. Heaton, Reedsburg; Charles W. Rodman, Ravenna, O.; Hiram Stedman, Berlin; J. Wolff, Max A. Berg, J. H. Cooke, Chicago; Lewis Brittain, Waukegan; G. H. Strong, Richland Centre, E. M. Highland, Clinton, Ia.; F. S. Copeland, La Crosse; M. B. Austin, Channing T. Gage, John Valentine, R. H. Pierce, Chicago; M. A. Warren, Baraboo.

Adjourned till 2.30 P. M.

2D DAY.—AFTERNOON SESSION.

The secretary read additional applications for membership from Jno C. McMynn (to become active member in addition to honorary). C. O. Baker. M. C. Wheaton, W. J. Ferris. The candidates were duly elected.

The remainder of afternoon was taken up with short papers and their discussion, the papers being as follows:

"COMPETITION," by Mr. Jno. Schuette;
"ELECTRICAL BUSINESS," by Chas. E. Gregory;
"COMMON COUNCILS," by P. H. Korst;
"WATER POWER," by Geo. A. Davis;
"PROFITS," by GEO. GRIMM.

Nearly all present joined in a more or less informal discussion of above papers after which the chairman declared the convention adjourned *sine die.*

CONVENTION NOTES.

It seemed to be the consensus of opinion of all present that the 3d annual convention was a "great success" and that much had been accomplished toward bringing the members in closer touch with one another. The comparatively large number of new members was especially noticeable.

THE NEW YORK INSULATED WIRE COS'. interests were well taken care of by their Mr. Jas. Wolfe, Chicago manager.

THE PAGE BELTING COMPANY, Chicago, were represented by their Manager Mr. J. Stedman.

THE METROPOLITAN ELECTRIC CO. was efficiently represented by their Mr. L. W. Burch, who also had a neat little exhibit of some of their more important specialties.

MR. GEO. S. DEARING, Chicago manager for the Hart & Hegeman Mfg. Co., combined business with pleasure and booked several nice orders for their well known switches.

MR. M. M. WOOD, Chicago, personally saw to it that his already popular electric light and railway specialties became still better known.

THE GOODRICH HARD RUBBER CO. distributed a neat folder calling attention to their numerous hard rubber electrical specialties.

THE CENTRAL ELECTRIC CO. in addition to their exhibit of Helios Lamps displayed a large assortment of specialties in charge of Mr. Latimer.

MR. F. S. TERRY, whose name and presence at once suggested "Sunbeams" reminded all central station men that after the clouds have cleared away, Sunbeams are sure to come, brighter than ever.. He also called attention to "C.-S." specialties.

MR. GEO. CUTTER, showed a line of sample of his various specialties, dividing his time between his exhibit and the several sessions, where he gave the members some points on Underwriters' regulations.

THE GENERAL ELECTRIC CO. had several exhibits and were represented by the irrepressible Mr. A. C. Bunce, assisted by Mr. M. C. Wheaton. A pair of Thomson '93 incandescent arc lamps were shown in operation and attracted considerable attention by their steady and uniform light.

THE ELECTRICAL ENGINEERING CO., of Minneapolis, distributed a neat and useful souvenir in the shape of a handsomely gotten up address book, calendar and memorandum book combined. Messrs. Totman and Chapman were in attendance, the latter especially in charge of the E. E. Co's new "Monogram" telephone apparatus, a complete private line being shown in use.

THE ENTERTAINMENT of the members and guests was by no means neglected. On Thursday evening a banquet was given at the Stadt Theatre Banquet hall. On Friday the members inspected the Milwaukee Street Railway Co.'s power house, one of the best planned and economically operated stations in the country.[1] After the inspection a special car took the members to the Pabst and Schlitz brewing establishments where something besides the eyes of the excursionists was delighted. A number also visited the Wisconsin Telephone Co.'s exchange. On the afternoon of the same day many took a special car for Wauwatosa as guests of the Milwaukee and Wauwatosa Electric Co.

S. F. B. MORSE & CO. of "Kerite" fame, always on the alert for something novel in the entertainment line, treated all visitors to a series of exhibitions by Prof. G. W. Patterson, expert in the art of club swinging. The professor will no doubt be remembered as having given some pleasing exhibitions of a similar character at the Trocadero in Chicago, during the World's Fair. The programme consisted of plain, musical and electrical club swinging, interspersed with musical selections. The electrical features invariably "brought down the house." By means of flexible cords current was conducted to a number of miniature lamps, with which each club was studded, the lamps being of the national colors, while at the ends of each club was fitted a 70 C. P. "Vapor" Sunbeam lamp. By proper manipulation of a suitable key board by an assistant, the most pleasing effects were obtained.

1. See THE ELECTRICAL ENGINEER, March 14, 21 and 28, 1894.

PERSONAL.

MR. F. R. COLVIN.

Mr. Frank R. Colvin has retired from the business managership of THE ELECTRICAL ENGINEER, to give his entire attention to the business of the Interior Telephone Co.

LETTERS TO THE EDITOR.

ERRATIC ENGINE GOVERNING DUE TO MAGNETISM.

EARLY in our history we had an experience with a small engine in which the leakage of magnetism from the dynamo into the frame of the engine and bedplate affected the efficiency of the outfit materially. But the governor was of the throttle type in which the balls were made of lead cast on steel springs; and as they actuated a brass valve moving in a brass seat, it made no difference in the regulation that we could find. Changing the dynamo over increased the efficiency of the apparatus considerably. We have never had the same trouble in any of the many direct connected outfits built since with automatic cut-off machines.

THE J. T. CASE ENGINE CO.

NEW BRITAIN, CONN.

CONTINUOUS CURRENT FOR ALTERNATING ARC.

I WAS much interested in reading the article by R. J. Feather in your issue of Jan. 2, entitled "Continuous Current from an Alternating Arc," and as the article seemed to invite discussion, I beg to offer the following explanation:

The path of a current crossing a magnetic field at an angle to the lines of force will be laterally displaced, if the conducting body be free to move. If the direction of either the current or the lines of force be reversed, the direction of this displacement will also be reversed. Applying these principles to the case given in the article, where the magnetic field is constant in direction and the current is being reversed continually, accounts very satisfactorily for the appearance of the flame from the arc in both directions.

I think however that the unidirectional current is due to the position of the electrodes in the extensions of the arc; that is, if they were of very small size, and placed in a plane at right angles to the carbons and directly in the centre of the arc, no current would flow through the galvanometer circuit, as there would be no difference of potential between them. If the electrodes be in the relative position shown in the sketch given in the article, I think the difference of potential between them could be satisfactorily accounted for.

A. W. K. PEIRCE.

SCRANTON, PA., Jan. 5, 1895.

EDISON ELEC. ILL. CO. OF NEW YORK.

The Edison Electric Illuminating Company held its annual meeting on Jan. 15. The annual report of Treasurer Williams showed net earnings of $789,466,58. The company has also received lamp royalties accruing previous to 1894 of $46,000; interest on bonds, $207,266,67, and dividends, $476,196. The list of directors is as follows: A. Boissevain, R. R. Bowker, C. H. Coster, Charles E. Crowell, Thomas A. Edison, W. E. Glynn, George F. Gregory, Arthur Curtiss James, D. O. Mills, George Foster Peabody, W. A. Reid, F. S. Smithers and Spencer Trask.

TOWER LIGHTING AT SANTA BARBARA, CAL.

Mr. W. H. Kincaid, city electrician of Santa Barbara writes us, with regard to the celebrated tower arc lighting in that beautiful Californian city: "The proposition was made to reduce the height of the two 125 feet masts to about 50 feet—the height of the other masts. Three of the four lamps on each of the two towers were then to be distributed around town, and thereby satisfy the complaining taxpayers. The boulevard is to be lighted by 42 incandescent lamps of 20 c. p. each. They are to be run in two series of 21 each on an alternating circuit of 1050 volts." This would imply that the tall towers now seen so far at sea, would come down.

LEGAL NOTES.

CURRENT REGULATION—THE THOMSON-HOUSTON DYNAMO REGULATOR PATENT DECLARED VOID.

THOMSON-HOUSTON ELECTRIC COMPANY *vs.* WESTERN ELECTRIC COMPANY.

In its issue of January 16 THE ELECTRICAL ENGINEER announced, in an editorial note, the dismissal of the bill in the above entitled suit by the U. S. Circuit Court, Northern District of Illinois, Judge Grosscup, January 14, 1895.

The case is one of much interest and far reaching in arc lighting interests. Its history is substantially as follows:

Suit on patent 238,315, March, 1881, to Elihu Thomson and Edwin J. Houston for "Current-Regulator for Dynamo-Electric Machines," was first begun against the Excelsior Electric Company. In this suit patent 223,659, January 20, 1880, to same inventors was joined. Both these patents show and describe almost identical apparatus for shifting brushes upon a commutator of a dynamo in response to changes of current strength. The suit against the Excelsior Company was settled and the records in that case were not before Judge Grosscup.

The next suit in which patent 238,315 was involved was that against the Citizens Electric Light Company of Boston, which used the Fuller-Wood dynamo and the Wood current regulator. This case now seems to have been inadequately defended, and was decided by Judge Colt in August, 1887, in favor of the patent. In this suit, which is known as the "Citizens" case, the only defense relied upon was the earlier Thomson-Houston patent on an almost identical device; that is, patent 223,659, which, in the Citizens case, was not declared on in the bill. Some time elapsed after the decision in the "Citizens" case before other steps were taken upon this patent. Then the Sperry Company was sued. A motion for a preliminary injunction was denied by Judge Blodgett. The Western Electric Company, finding that its interests would be prejudiced if the case against the Sperry Electric Company were not adequately defended, sought to intervene in order to be made a party defendant. Judge Blodgett denied the petition, but it had the practical effect of compelling the Thomson-Houston Electric Company to bring suit against the Western Electric Company, which they then did. This was in 1890, and since then the record has been built up to 2,500 pages. The counsel for complainant who appeared at various times were Messrs. F. P. Fish, R. S. Taylor, George R. Blodgett, H. A. Seymour and Leonard E. Curtis, besides the local solicitors of the Thomson-Houston Company, Offield, Towle and Linthicum. The experts for complainant were Professors Cross and Thomson; the counsel for defendants were Messrs. Geo. P. Barton and Chas. A. Brown and their experts were Messrs. C. E. Scribner, Thos. D. Lockwood and Ernst P. Warner. It was admitted at the hearing that Mr. Scribner had demonstrated the true theory of the operation of dynamo electric machines as against the explanation of Professor Cross.

In addition to the ordinary defense of non-infringement and lack of patentable invention, the defendants relied principally upon two defenses; first, that Hiram Maxim was the prior inventor, and second, that Thomson and Houston in their patent 223,659 had shown, described and claimed a device of which the patent in suit claimed only a function. It was shown that Maxim, prior to the invention of the patent in suit, had invented an automatic brush shifting regulator by which he kept the potential constant for multiple arc service. The complainant contended that this was not the same thing as the automatic brush shifting regulator for keeping the current constant.

The main contest was waged over the prior Thomson-Houston patent which, defendants claim, showed a device which operated, and could only operate, as a current regulator. Complainant contended that this earlier device operated to keep the potential between adjacent segments of the commutator at a minimum. Defendants replied that in properly constructed machines the two things are the same, and merely different ways of stating the same fact. The great bulk of the record relates to theories and tests regarding this point.

The hearing occupied four days last June, and was participated in by Messrs. Fish and Taylor for the complainant, and Messrs. Barton and Brown for the defendants.

In his opinion Judge Grosscup, after setting forth the points at issue and the characteristics of the case, says:—

"The claims of the patentees are for a combination and are expressed in the following terms:

"1. In a current-regulator for a dynamo-electric machine, the combination of a device responding to changes in the main or generated current, a shifting commutator for said machine, and mechanism controlled by said responsive device to shift the commutator to those positions where the current taken up by said commutator shall be constant.

2. In a current-regulator for a dynamo-electric machine, an electro-magnetic device acted upon by variations in the main or generated current, an adjustable or shifting commutator for the machine, and mechanism controlled by said electro-magnetic device to adjust the commutator to those positions where the main or generated current taken up by said commutator shall be constant."

* * * * * * *

"The principal defense is that, in view of the prior state of the art, and especially of the invention patented by Thomson & Houston, January 20, 1880, No. 223,659, this so-called invention has been anticipated, and the patent, therefore, is invalid. Much learning on this question by counsel for both sides, and by the experts called, has been put at the disposal of the court. * * * *

"Patent 223,659 discloses a device almost identical with that of the patent in dispute. As stated already, the commutator is made up of a number of subdivisions called segments which are electrically insulated from each other. In the revolutions of the commutator each of these segments comes into contact, first, with one brush, then with the other, and as the contact is broken by the passing of the segment away from the brush, there is a tendency to form a spark between the tip of the brush and the edge of the leaving segment. When such sparking is violent, or repeated, it eats away the metal surfaces between which it occurs and is, in every respect, disadvantageous. Whatever may be the cause of the sparking, it was then discovered or known by the patentees, that a proper shifting of the brushes upon the commutator, would bring about a condition of minimum sparking. But the position of the brushes upon the commutator, to prevent sparking, was not necessarily uniform. It depended upon the speed of the revolutions which, in turn, was dependent upon the uniformity of power, not so easily obtainable then as now. It depended also upon the accidental or purposed introduction or withdrawal of resistance from the circuit. It is apparent that a shifting by hand to meet these varying conditions would be both cumbersome and unsatisfactory, and the invention patented as 223,659, was to meet these electrical difficulties.

"The object here, and in the subsequent patent of Thomson & Houston, was to obtain a device that would move the brushes backward and forward responsively to the electrical condition that such movements were intended to meet. For this purpose, the patentees employed a mechanical device in every substantial respect like that described in the patent in suit, except that the electro-magnet was put in the short circuit beginning with the forward member of one of the brushes, and ending in the main circuit at the rear of the other member of the brush, instead of having been put in the main circuit, as in the patent in suit.

"It may be admitted that the anti-sparking device is, in some respects, different from the one in suit. The question is, whether the difference is one of principle and conception or only such a difference in use as leaves the uses, nevertheless, analogous.

"The complainant's anti sparking patent revealed to the public a device by which the brush on the commutator could be automatically changed forward and backward responsively to a change in the current of electricity. The device, it may be admitted, was only used to prevent sparking, and was only acted upon by a small portion of the current, but it disclosed clearly and for all purposes, a mechanism that would rock the brushes responsively to changes in the current, irrespective of whether such currents were the main, or only accessory, ones. The problem sought to be solved by the patent in suit was a somewhat different one in its ultimate ends, but the object of both patents was reached by the application of any principle, and the use of any device, that would automatically maintain constancy of current, notwithstanding changes of motive power or of resistance. The fact that one may be intended to prevent destructive effects upon the machine itself, and the other to adapt the machine to the circumstances of changing resistance, will not make both devices patentable, if they employ substantially the same principles and the same mechanism. It seems clear to me that the real immediate use intended by both of these patents was to automatically equalize the volume of the current; the one, in the less, and the other, it is true, in a much greater degree. The immediate objects in view were thus analogous, and the ultimate uses into which they diverged, do not make them less so.

"Now, if the uses were analogous, and the principles and devices employed were somewhat different, the sole question remains, whether an electrical mechanic, having the knowledge of the art that the public possessed when the so-called invention in suit was conceived could, without invention, have adapted the anti-sparking mechanism to the analogous uses of the patent in suit?

"It must be remembered that it was then well known to electricians that the shifting of the brushes forward and backward upon the commutator increased and diminished the volume of the current, and thus equalized it against the tendencies of a changed resistance. This is what the anti-sparking invention accomplished automatically within narrow limits. It is what the so-called invention in suit accomplished automatically through a wider scope. To an electrical mechanic bent upon devising a remedy for the inconstancy of the current caused by the putting in and taking out of the lamps, and possessed of the knowledge that a shifting of the brushes on the commutator would accomplish this, and that such shifting, within very narrow limits at least, could be accomplished automatically by the anti-sparking invention, the sole problem presented was whether, by a like device, an automatic shifting of the brushes through a wider scope, and adapted to the whole current, could be effectuated. The mechanical idea and conception, and the principle on which it was based, were all before him. There was required simply experimentation to determine its adaptability to the new purpose. Doubtless such experimentation was difficult and delicate, and called into exercise a multitude of different adjustments of the brushes. But, it was all done in the light, and along the lines, of the earlier device and of electrical principles well known to the public. It was, in my mind, adjustment purely, and not a new conception of either a principle of electricity, or a mechanism to carry it out. If there is any mistake in this judgment it is, I think, in putting a higher estimate upon mechanical skill in electrical fields than is applied to other fields, but, I do not see how this can or ought to be avoided. It necessarily requires high skill to be an electrical mechanic at all. Adjustments and adaptations are there every day made use of. To give to each of these the dignity and consequence of inventions would tie up permanently this whole useful field to monopoly. No new distinct conception or discovery ought practically to go unrewarded. But, it certainly would, if its re-adaptations, by experiment or adjustment, to the thousand uses the field of electricity discloses, were to be regarded as patentable improvements. I differ from Judge Colt in this case with reluctance, for I defer to his superior experience and wisdom, in the patent field, but I cannot follow him in this case without violating my own sense of judicial responsibility.

"The bill will be dismissed."

A CURIOUS WESTERN UNION LIBEL CASE.

State Senator Samuel D. Peterson of St. Paul, Minn., has obtained against the Western Union Telegraph Company a verdict of $10,000 in a unique suit. Two years ago, during the Senatorial election, at which Davis was chosen to succeed himself, Senator Peterson voted against Davis, and a number of Republicans sent Peterson a telegram, signed simply "Many Republicans," reflecting on his honesty. The Western Union Company refused to give the names of any of his traducers, so he sued the telegraph company for libel and was awarded a verdict,

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JAN. 15, 1895.

Alarms and Signals:—

Railway Block Signal, W. Berrigan and W. H. McClure, Elmira, N. Y., 532,-633. Filed Sept. 18, 1894.

Distribution:—

System of Power Transmission, C. S. Bradley, Avon, N. Y., 532,441. Filed Sept. 12, 1893.
A reciprocating electric drill system comprising a reciprocating generator with the armature wound with two or more circuits longitudinally displaced; the polyphase currents developed are transmitted to the reciprocating drill.

Dynamos and Motors:—

Alternating Current Motor, L. Gutmann, Pittsburg, Pa., 532,549. Filed Aug. 27, 1890.
The invention consists in the peculiar armature adapted to considerably reduce self induction and in a novel construction of field magnets.

Electro-Metallurgy:—

Magnetic Separator, H. Arden. Seattle, Wash., 532,742. Filed Aug. 15, 1894.

Lamps and Appurtenances:—

Carbon Filament and Method of Manufacturing Same, A. D. Little, Boston, Mass., 532,468. Filed June 18, 1894.
The material consists of cellulose acetate produced by heating cellulose with acetic anhydride.
Electric Arc Lamp, A. Chester and J. J. Rathbone, London, Eng., 532,531. Filed Mch. 26, 1894.
Relates more particularly to an automatic cutout.

Measurement:—

Galvanometer, A. H. Hoyt, Penacook, N. H., 532,559. Filed April 25, 1894.
The needle is placed in the centre of a solenoid and is also acted upon by pole pieces energized by the solenoid.
Galvanometer, A. H. Hoyt, Penacook, N. H., 532,560. Filed April 25, 1894.
An alternating voltmeter, an improvement on the same inventor's previous instrument Patent No. 497,499, May 16, 1893.
Galvanometer, A. H. Hoyt, Penacook, N. H., 532,561. Filed April 25, 1894.
An instrument in which the armature to which the indicating needle is attached is placed in the centre of a solenoid with its axis perpendicular to the axis of the solenoid.

Miscellaneous:—

Surgical Instrument, E. E. Johnson, Denison, Tex., 532,666. Filed Sept. 28, 1894.
Instrument for examining and treating internal cavities, canals, etc., of the body.
Mechanical Toy, A. Martin, London, Eng., 532,678. Filed Oct. 15, 1894.
The figures or objects are given an eccentric gyratory movement by the revolution of a vertical spindle which revolves in contact with various shaped magnetic strips to which the figure is attached.

Railways and Appliances:—

Conduit Railway Trolley, W. T. Dulany, Jr., New York, 532,448. Filed March 30, 1894.
A special arrangement of conduit trolleys so that if the wearing plate on one side of the standard becomes cut the plate conductor on the opposite side transmits the current.
Conduit Electric Railway, W. T. Dulany, Jr., New York, 532,449. Filed Aug. 16, 1894.
Similar to the above.
Trolley Catcher, M. Van B. Nichols & J. A. Fraser, Port Arthur, Can., 532,477. Filed May 26, 1894.
Controller for Electric Cars, H. P. Davis, Pittsburg, Pa., 532,538. Filed Apl. 14, 1894.
A device by which the proper position of the controller is insured before the handles for moving the same can be removed.
Closed Conduit Electric Railway, G. W. McClintock, Wollaston, Mass., & D. J. McLane, Quincy, Mass., 532,576. Filed July 2, 1894.
The successive sections of an exposed conductor are charged as the car passes over the line.
Closed Conduit Electric Railway, J. Schnepf, New York, 532,590. Filed Sept. 9, 1893.
A flexible or chain conductor lies in an insulated conduit and is drawn upwards into contact with metallic plates from which the current is conducted to the motor.
Converter System for Electric Railways, C. F. Scott, Pittsburg, Pa., 532,593. Filed July 31, 1893.
Improvement on the patent of G. Westinghouse, Jr., No. 404,189, May 28, 1889. The sectional conductors when not employed in feeding car motors are supplied with an extremely low potential which may be gradually raised, by which means the leakage is greatly reduced.

Switches and Cut-Outs:—

Automatic Circuit Breaker, H. P. Davis, Pittsburg, Pa., 532,537. Filed Feb. 28, 1894.
Embodies a movable contact piece controlled by an armature which is acted upon by the solenoid magnet.
Contact Device for Electrical Appliances, F. W. Schindler-Jenny, Kennelbach, Austria-Hungary, 532,588. Filed Feb. 19, 1894.
A device for cutting in or out sections of a conductor consisting of an insulating block with metallic contacts.
Non Arcing Switch, C. F. Scott & H. P. Davis, Pittsburg, Pa., 532,594. Filed Mch. 29, 1894.
A pair of separable contacts are in shunt to the main switch with one or more of the movable contacts in a restricted chamber and a vent communicating with the interior of the chamber.
Electric Elevator and Motor Controller, R. Wilson, Louisville, Ky., 532,514. Filed June 23, 1894.
A semi-automatic starting and speed regulating mechanism device, by which the quick lever movements of the operator are transmitted gradually to the circuit changing devices.
Electric Switch, W. P. Hancock, Everett, Mass., 532,663. Filed Nov. 27, 1894.
A quick-breaking switch actuated by a spring.

Telephones:—

Annunciator for Telephonic Circuits, T. Spencer, Cambridge, Mass., 532,605. Filed Sept. 10, 1894.
A self restoring drop.

REPORTS OF COMPANIES.

LA ROCHE ELECTRIC WORKS—AN ASSIGNMENT.

In respect to the assignment made by the La Roche Electric Works, Mr. J. Franklin Stevens, Assignee, (treasurer of the Company) makes the following statement: "At the annual meeting of the stockholders of the company held on the 9th inst., it was decided that owing to the existing trade conditions, difficulty in making collections and the prevailing local conditions by which we were directly affected, the best policy for our company to pursue was to liquidate and retire from business while still solvent. Therefore in order to protect our assets, it was decided to make an assignment to the writer, the deed for which was executed on the 9th inst. We regret that we should be compelled to ask you to wait a short time for a settlement of your account, but wish to assure you that payment will be made you in full as soon as the assignee can realize on the assets now in hand. The assignment was made purely for the benefit of our creditors and no preference given. We are now making arrangements for a prompt disposal of our equipment and the collection of monies due us. As soon as the above is consummated, remittance in full will be made to all creditors."

Mr. Stevens informs us further that Mr. F. A. La Roche, president of the assigned company, "having associated with himself certain gentlemen of undoubted financial standing, proposes to purchase the entire equipment of the La Roche Electrical Works and will continue the business with increased facilities."

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 93d Meeting of the Institute was held Wednesday evening Jan. 16, President Houston in the chair.

Prof. Macfarlane of Ithaca, N. Y., read his paper "On the Units of Light and Radiation," which was discussed by Messrs. Kennelly, Wolcott and Burnett. It was voted that the paper be referred to the Committee on Units and Standards for their consideration.

The paper by Mr. Alton D. Adams, of Boston, on "The Best Metal for Field Magnet Frames," was read by the author and discussed by Messrs. Crocker, Fleming, Sheldon, Ashley, Burke, Waldo, Bliss and Dunn.

At the Council Meeting in the afternoon the following Associated Members were elected:—

Henry S. Anderson, General Manager and Electrician, United Electric Light Co., Springfield, Mass.; H. W. Buck, Student in Electrical Engineering, Columbia College, N. Y.; Edmund V. Cox, Student in Electrical Engineering, Columbia College; Sylvester P. Denison, 143 Centre Street, New York City; Arthur J. Farnsworth, Chief Engineer, Larchmont Electric Co., Mamaroneck, New York; Henry W. Fisher, Electrician and Director of Elec. and Chem. Laboratories, The Standard Underground Cable Co., Pittsburg, Pa.; Henry Leslie Fridenberg, *M. E.*, Student in Electrical Engineering, Columbia College, N. Y.; Edward B. Gallaher, Electrical Engineer, 253 Broadway, room 910; J. Henry Klinck, Graduate Student, Cornell University, Ithaca, N. Y.; Burton S. Lanphear, Fellow and Graduate Student in Electrical Engineering, Cornell University, Ithaca, N. Y.; Edward A. Leslie, Vice-President and Manager Manhattan Electric Light Co., L't'd. N. Y. City; William B. Lester, Western Union Tel. Co., 195 Broadway, New York City; John Clifford Rennard, *A. B. E. E.*, Assistant to Electrical Engineer, Met. Telephone and Tel. Co., New York City.

The following Associate Members were transferred to Membership:—

Peter Wright, Inspector of Electrical Works, United Gas Improvement Co., Philadelphia, Pa.; Arthur V. Abbott, Chief Engineer, Chicago Telephone Co., Chicago, Ill.; Louis B. Marks, Electrician, Marks-Ayer Electric Co., 78 Watt St., New York City; Edward V. Baillard, Manufacturer of Electrical Instruments, etc., 108 Liberty St., New York City; Francis Broadnax, Engineer, Safety Insulated Wire and Cable Co., New York City.

N. E. L. A. TRANSPORTATION.

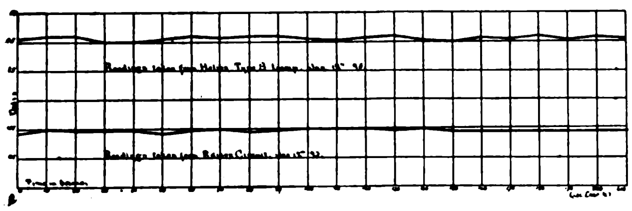
Mr. C. O. Baker, Jr., master of transportation, notifies us as follows:—"The Trunk Line Association have granted a rate of a fare and a third for the round trip, on the certificate plan, for members and delegates attending the Cleveland convention, to be held February 19, 20 and 21. Negotiations are now pending for a special train from New York to Cleveland, notice of which will be given as soon as route is selected and schedule arranged."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

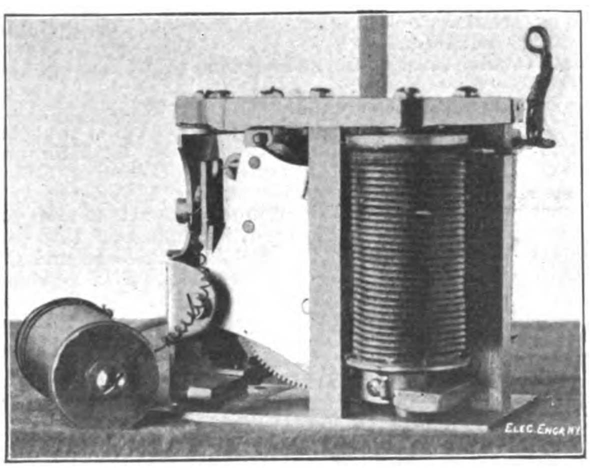
CENTRAL ELECTRIC CO. AND THE HELIOS LAMP.

CONSIDERABLE attention was shown the exhibit of the Central Electric Co. in charge of their Mr. Chas. G. Burton, at the Milwaukee Convention. The special feature consisted of a pair of Helios (Type S) constant potential arc lamps. They were shown in operation, two in series, current being obtained from the mains of the Hotel Pfister. The regularity and smoothness of the feeding was commented upon by nearly every one who watched the action of the lamps. In the accompanying curves, the upper shows record of the voltage of one of these lamps, taken a few days before the Convention. It will be noticed that at no time was there a variation of over two volts, and that, it would seem, was to a great extent due to the variations of the supply circuit itself, as shown by the lower curve, which represents the voltage of the circuit, readings being taken simultaneously.



CURVES SHOWING REGULATING OF HELIOS ARC LAMPS.

The most important feature however, shown by Mr. Burton consisted of the projection of the arcs, by means of lenses, upon a large screen, demonstrating the claims of the Helios Company that the lamps would not under any circumstances "see-saw" or rob each other, to be true. This was a rather novel and ingenious method of showing the actual operation of arcs under these conditions and developed many new features of the formation and condition of the carbon points at the arc, which could hardly be studied in a better and more convincing manner.



THE HELIOS ARC LAMP MECHANISM.

Naturally it will be asked "How is this ideal regulation accomplished by the lamp?" The new "Type S" Helios lamp is claimed by the makers to be constructed upon entirely new principles. The illustration, shows the mechanism of the lamp. It consists primarily of a pair of feeding coils connected in shunt to the arc controlling an escapement. The lamp has also a pair of arc-striking coils, which however perform no office except to strike and maintain the arc. The lamps are of the escapement feed type, but unlike other mechanisms of similar character, the feeding is in no way identified with the series or arc maintaining coils, depending entirely upon the variation of resistance and the consequent change in voltage between the carbon points. The natural consequence of this action is that the conditions that exist in a lamp or pair of lamps may embody entirely opposite stages of feeding. For instance, assuming that one of the lamps is about to feed, the condition of the other lamp, as regards the feeding point, will in no way affect the action of the first lamp; or should both lamps feed or be about to feed at the same instant, the operations will still take place independently of each other.

The operation of the lamp is as follows: The circuit being open at the switch and the carbons in contact,—which is the normal condition when lamps are idle,—the escapement is out of gear with the rod, the latter being free to move for trimming or adjustment. On closing the switch the arc-striking coil attracts the rack armature, thereby lifting the rod, determining the arc and locking the escapement. At the same time the feeding coil armature is thrown in position to be attracted when feeding becomes necessary. The feeding armature being attracted the requisite distance, the escapement balance is released and the carbon rod falls by gravity. At the same instant, however, the shunt or feeding circuit is opened by the rocking lever leaving the escapement balance. This action leaves the feeding coil without current, allowing its armature and rocking lever to assume their normal position, ready for the next feeding impulse. In this lies the great advantage claimed for an open circuit lamp, because should lamps from any local cause open the circuit, the shunt coils would be open and free from any liability to burn out or even heat. The making and breaking of a shunt circuit will naturally suggest burnt contacts with attending unreliability and perhaps final destruction, but this objection is entirely overcome by the introduction of sterling silver contacts which the makers claim they have found to be far superior to any other metal heretofore used.

BRADBURY-STONE BATTERIES.

The Bradbury-Stone Electric Storage Co. of Lowell, Mass., write us: "We note you state in your issue of January 2d, '95, page 14, article on Philadelphia Electric Police Launch, that the battery is operated by cells manufactured by the Electric Storage Battery Company of Philadelphia. Kindly correct this to read Bradbury-Stone Electric Storage Co., Lowell, Mass."

FAN MOTORS FOR HEATING PURPOSES.

Mr. R. J. Feather, of the Edison Electric Illuminating Co. of Piqua, O., writes us the following as to a new and ingenious use for the fan motor. "I would like to state a use for the ordinary fan motor, which is generally used for cooling a room. It may, I find, be employed to great advantage in a cold snap by placing one of them before the steam radiators in universal service, and thus forcing the air between the coils of the radiator. Evidently this arrangement will greatly increase the heat-yielding capacity of the radiator by diffusing the heat more rapidly and steadily, and instead of the heat being greatest close to the radiator, a circulation of air is set up, which spreads the heat to every part of the room equally. This idea may help other readers of your journal to maintain the temperature of their rooms sufficiently high and even, if they have fan motors."

MOORE & BAYLIS.

Under the above firm name Messrs. A. T. Moore and Chester Baylis have established themselves as manufacturers' agents, with headquarters at Buffalo, N. Y., and covering the territories of Northern and Western New York and Western Pennsylvania.

They will handle all kinds of railway, electric light and power supplies and have already secured the agencies of the following well known concerns: The Walker Mfg. Co., The Safety Insulated Wire & Cable Co., The Fiberite Co., Thompson & Allen, Sunbeam Incandescent Lamp Co., and the Helios Electric Co.

ERNEST WILLIAM COOKE.

MR. ERNEST WILLIAM COOKE, late Director of the School of Mechanical Engineering, Armour Institute, Chicago, has opened an office in that city, acting as manufacturers' agent, for the sale of a number of electrical, steam and other high grade specialties, with a territory covering the States of Michigan, Indiana, Illinois, Wisconsin and all the States west of the Mississippi River. Mr. Cooke has already secured the agency of the Mason Regulator Co., of Boston, manufacturers of steam specialties, the Pecora Paint Co., of Philadelphia, manufacturers of enamel paint for metals, and will add several other standard specialty manufacturers to his list. Mr. Cooke is a "pusher" and can be depended upon to make a good showing.

DYNAMOTORS FOR THE NEW LIBRARY OF CONGRESS.

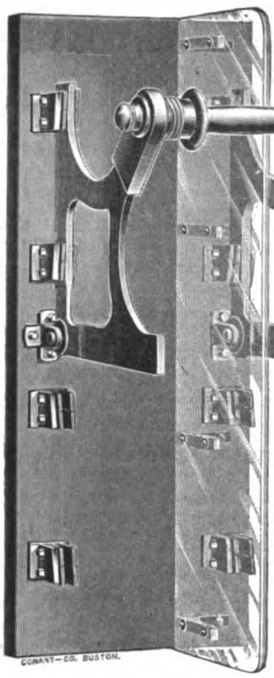
Bids were opened as below, on Jan. 16, by the superintendent of construction of the new building for the Library of Congress, for dynamotors. The variations in price are, to say the least, interesting. Jackson & Couridson, Madison, Wis., $2,100; Western Electric Co., New York, N. Y., $4,725; McCay Howard Engineering Co., Baltimore, Md., $3,345; Royce & Marean, Washington, D. C., $4,750; General Electric Co., New York, N. Y., $3,100; Crescent Electric Machine Co., Brooklyn, N. Y., $2,672.

THE HERRICK HIGH POTENTIAL SWITCH.

We illustrate a new type of high potential knife switch designed by Mr. Charles H. Herrick, E. E., No. 133 Oliver street, Boston, Mass., and manufactured by the well known firm of W. S. Hill Electric Co., No. 133 Oliver street, Boston, Mass. The engraving shows one of a group of six of these switches now in use by the Narragansett Electric Lighting Co., of Providence, R. I., where they are successfully carrying currents of 400 amperes at 1000 volts, alternating.

With the advent of large direct current generators a need for a switch to handle and transfer the heavy currents was felt and Mr. Herrick has successfully met the demand. It will be seen that the switch has a very quick break; it has a flash guard between its opposite poles, breaks both machines, and circuit, and has its yoke at a point of absolute safety both to operator and switch. In operation there is no flash when the switch is thrown and it causes the slightest possible "wink" in the lamps to which it supplies current.

The illustration shows a switch adapted for use on the front of switchboards, but designs have been completed for the same type of switch to be placed on the rear of the board. This type is operated by a lever and handle extending through a slot cut in the switchboard. The switch has solid cast copper blades, micanite insulations on yoke and the well known Hill reinforced contacts, and will be given a carrying capacity of 50 per cent. in excess of its regular duty to allow for all reasonable overloads.



Herrick High Potential Switch.

It is adapted for all varieties of duty from 110 and 500 volt circuits to those carrying 2,000 volts and over, alternating.

It is the intention of the Hill Company to build these switches in all sizes and types as demand may arise for them and they design this switch to perform any special duty and guarantee results. The Hill Company have given it the name of the "Herrick High Potential Switch."

As stated above, our illustration shows the switch in use on the alternating switchboard designed by Mr. Herrick for the Narragansett Electric Lighting Co., which is capable of handling 50,000 to 100,000 16 c. p. lamps. The design of this board is such that all changes of machines and circuits are made instantly and without the use of plugs or cables of any sort. The generators can be arranged to run in multiple, or independently as desired, provision being made in the design of the board to admit of this feature. This board was also the product of the Hill Company's shops and is strikingly handsome, being 22 feet long by 6 feet high and the material Italian marble. The Hill Company will be glad to answer all inquiries, and make quotations, etc., to all who may be interested.

Attleboro, Mass.—The new electric light station for the North Attleboro Steam & Electric Co., at Attleboro, Mass., has been completed by The Berlin Iron Bridge Co., of East Berlin, Conn. The building is 62 ft. wide and 100 ft. long, entirely fire proof, covered with the Berlin Company's patent anti-condensation corrugated iron.

THE GARLOCK WATER PROOF HYDRAULIC PACKINGS.

The constant demand for a superior packing for the plungers and pistons of pumping and hydraulic machinery induced the Garlock Packing Co., of Palmyra, N. Y., to produce a packing which would meet all requirements. After many years of experiment and at a considerable expense they have succeeded in producing a water-proof hydraulic packing which is claimed to answer all purposes. This packing is the outcome of practical tests, in the water ends of pumps, plungers, pump pistons and hydraulic elevators and hydraulic machinery, and has proved itself a first-class water-proof packing for light or heavy duty. It is made of the best flax and thoroughly lubricated with a water-proof compound, which is strictly free from acid, and is manufactured in all sizes up to two inches.

The best rawhide hydraulic packing, which will answer the purpose well for a time, is said to soon become water-soaked and soft from the use of oils, losing its strength and necessitating constant repacking. This packing is intended to resist excessive pressures and retain its solidity. One of the company's principal claims is that it is absolutely water-proof and oil-proof.

A NEW ELECTRIC LIGHT STATION FOR SING SING, N. Y.

The Sing Sing Electric Lighting Co. are building a new lighting station on a dock at the river front. The building is of brick covered by an iron roof with anti-condensation lining, furnished by the Berlin Iron Bridge Co. The building is divided into two equal parts by a brick fire wall, one end to be used as a boiler room and the other for the engines and dynamos. The floor will be of concrete, making the entire building, with the exception of doors and windows, completely fireproof.

The steam plant will consist of two 180 h. p. National water tube boilers, one Westinghouse standard and two Westinghouse compound engines aggregating 300 h. p., and a 300 h. p. National heater. Each engine will be provided with a 5-inch Westinghouse separator.

The building is so located on the dock, as to leave room on the river end for the coal bunkers, the coal being unloaded directly from the boats, lying at the end of dock, into the coal bins. The boilers are located in the west end of the building and three openings through the west wall enable the coal to be handled with a minimum amount of labor.

The electrical equipment will consist of three Westinghouse 45 k. w. alternators with the necessary exciters. The building is large enough to double the present boiler plant and add another 100 h. p. engine and dynamo. By the use of a double roof with two gables on each side, instead of a single roof with a gable at each end—the usual construction—the company will be able to increase their capacity to any extent by moving one side wall the requisite distance and extending the roof.

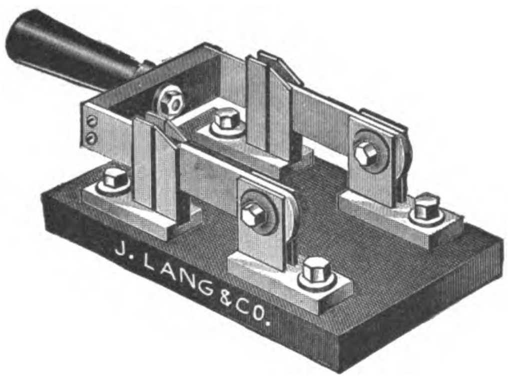
THE METROPOLITAN ELECTRIC CO.

The advent of the new year was probably of more than ordinary interest to this well known and representative Chicago firm, for just a year ago, or to be precise, on January 15, 1894, the Company took possession of their new and enlarged quarters at 186-188 Fifth Ave. While the business outlook at that time was far from encouraging and the still unsettled condition of trade in general would have deterred many a business man from making any extensive preparations for a larger business, Mr. W. H. McKinlock, the president of the company believed that in order to satisfy the demands of the electrical trade it was necessary at all times to carry a complete, well assorted stock and to have the proper facilities for filling orders promptly and accurately. That this belief was well founded is shown by the fact that during the year just ended, the business of the Metropolitan Electric Company has been constantly increasing, the increase last year, in spite of the dull times, being over 20 per cent., and this increase, we are told, was not of the sporadic kind but the good healthy increase which invariably attends a properly and judiciously conducted business. While the company carries at all times a complete stock of all staple goods, they also handle a line of several important specialties, among which may be mentioned the P. & B compound and tape, Metropolitan incandescent lamps, "N. I. R." rubber covered wire, "I. X. L." W. P. wire, "Royal" transformers, "Badger" overhead railway material, Knox circuit breakers, the Allen soldering stick, etc. They are also agents for the Commercial Electric Company's apparatus and the American Heating Company's electric soldering iron. That the popularity of the company is not confined to the United States is attested by the fact that they not only have a good trade in Mexico but have even shipped goods to Europe.

The officers of the company are: W. H. McKinlock, President and Treasurer; W. C. McKinlock, Secretary; W. F. Richardson, Assistant Secretary; H. H. Small, Manager, and Otto Reiman, Cashier and Auditor.

LANG STATION SWITCHES.

Messrs. J. Lang & Co., Chicago, the well known manufacturers of station switches and other electrical specialties, not content with the already high grade of their goods, have recently made several changes in their station switches, tending to still further improve their quality and efficiency. Our illustration shows one of their latest double pole switches, which they are now making in sizes of from 50 amperes carrying capacity up to 3000 amperes and larger. They also make double pole, double throw switches



Lang Station Switch.

of the same pattern and sizes. The connecting straps and contact clips are made of pure copper and all cast metal used in these switches, as well as in all their other electrical specialties, will carry, it is claimed, from one third to one half more current than any other cast metal made. The result is that the Lang switches never heat unless excessively overloaded. In addition to the above described switches Messrs. Lang & Co. still manufacture their well known loose tongue "Andrews" and Lang switches in all regular sizes. They now have in preparation a new and revised catalogue of all their switches and specialties. It will be ready for distribution at an early date. Their address is 44 Michigan St.

NEW YORK EDISON CO. EARNINGS.

Mr. Jos. Williams, treasurer of The Edison Electric Illuminating Co. of New York, has issued the following statement of comparative earnings.

	1894.	1893.	
	December.		
Gross	$165,994.33	$143,191.50	$22,802.83 Inc.
Net	81,358.64	74,968.43	6,390.21 Inc.
	Twelve Months.		
Gross	$1,464,336.44	$1,245,524.87	$218,811.57 Inc.
Net	789,466.58	605,642.72	183,823.86 Inc.

THE NICHOLSON FILE COMPANY CATALOGUE.

The Nicholson File Company, of Providence, R. I., has issued an exceptionally fine catalogue profusely illustrated with wood cuts of their files, rasps and tools, and with excellent reproductions of wash drawings showing the various departments of the company's extensive works. The book is bound in cloth and contains upwards of 60 pages 11 x 14 inches. First comes a short account of the company and of its founder, William T. Nicholson, with an excellent portrait. This is followed by illustrations and text descriptive of the various kinds of files in common use. The illustrations are among the best we have seen, and are so accurate as to enable selections to be made as nearly as possible as though the files themselves were presented. Among these are shown the Nicholson "increment cut" files and rasps, the Nicholson "X. F." files, files for manicure use, and three pages of tools and specialties manufactured by the company. Much general information is also given that cannot fail to be of value to those selecting and ordering files.

NEW ENGLAND NOTES.

The Garlock Packing Co., of Palmyra, N. Y., have recently established a New England branch with offices and salesrooms at No. 12 Pearl street, Boston, Mass. Mr. John D. Lane, for many years travelling salesman of the company, has been appointed general manager of the New England branch.

The Thompson-Brown Electric Co. of Boston have opened at their store a free bureau of registry for the purpose of supplying central stations, railroads and contractors with every class of electrical help. All desirous of obtaining positions are invited to register, and after their credentials are examined, they are recommended to positions which the Thompson-Brown Co. have been requested to fill. This Company are also getting out an entirely new line of electric railway line material, which promises to take electrical contractors by storm. It is entirely novel, and based on sound, common sense engineering principles.

NEW YORK NOTES

Mr. Max Osterberg E. E. is delivering a course of lectures on electricity for the Board of Education, in connection with their free lectures for the people.

Mr. W. H. Fleming informs us that he has revoked all his agencies and that in the future all orders for the Fleming woven wire brushes should be sent direct to him at the factory, No. 393 Pearl St., New York.

Mr. Chas. Blizard notifies us that the New York office of the Electric Storage Battery Co., of Philadelphia has been moved from 45 Broadway to the Manhattan Life Insurance Co.'s building, 66 Broadway, in order to keep pace with the increased business of the Company.

Wallace & Sons announce that they will shortly issue a new catalogue of their rolling mill products in brass and copper, and will be glad to receive applications for it from all interested. It will contain the latest revised price lists of goods of their manufacture in wire, sheets, tubes, pins, rivets, lamps, brass rail, &c.

Treasurer Fessenden of the Hope Electric Appliance Co., of Providence, R. I., was a recent visitor to New York and a welcome caller at The Engineer office. Mr. Fessenden takes a philosophical view of the general situation and a very hopeful view of the future for the standard specialties made by his company.

Abendroth & Root Boilers are gaining a noticeably strong foothold in all the newest and latest electrical engineering work. The Abendroth & Root Mfg. Co. of 35 Cliff street make an interesting announcement in this issue relative to their improved Root water tube boiler and the many central stations and power houses of modern type into which it has been successfully introduced.

The New York Standard Construction Co., of 97 Nassau street, this city, have secured a contract to build the Batavia Street Railroad operating upon the streets of Batavia, N. Y. and to Horseshoe Falls, about 7½ miles. Work will be commenced next March. The company has also secured the contract for changing to an electric road the line of the Madison, Ind., street railway, and extending the tracks. Work on the Somerset railway, at Crisfield, Md., will also be commenced in the Spring.

PHILADELPHIA NOTES.

Philadelphia Electrical Equipment Co., has dissolved by mutual consent, Mr. Carl P. Young retiring from the business, but the other partner Mr. James R. Rettew will continue the business under the old name at 816 Cherry street.

WESTERN NOTES.

The Late F. E. Degenhardt is the subject of a little "in memoriam" brochure issued by the Standard Underground Cable Co., who will be glad to send copies to any of Mr. Degenhardt's friends and admirers.

The Metropolitan Electric Company, 186–188 Fifth avenue, Chicago, have recently been making some changes in their store and have put in some new counters and shelving, thus adding to its attractiveness and furnishing better facilities for the display of their increased line of goods.

The University of Chicago has bought from Prof. W. W. Payne the scientific magazine called *Astronomy and Astro-Physics* and will hereafter publish it as *The Astro-Physical Journal*. The first issue in the new series has appeared, is full of most interesting matter, and gives every evidence of being a valuable aid to all interested in spectroscopy and astronomical physics.

Electric Appliance Co. Every enterprising advertiser is continually on the look-out for something entirely new in the line of an advertising novelty. The novelty advertising field is so thoroughly worked, however, that it is not at all an easy matter to bring out something new and when such an article does appear, it is quite sure to attract considerable attention. The Electric Appliance Company claim to have something entirely original in this direction in an advertising novelty which is something that every electric light man in the country has been in need of ever since he went into business, but an article which the market has failed to supply.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

Vol. XIX. JANUARY 30, 1895. No. 352.

THE MEXICAN CENTRAL RAILWAY TELEGRAPH SYSTEM.

BY

George Heli Guy.

AMERICANS are just now looking to Mexico as a promising field for commercial enterprise in the near future. The resources of the country are almost incredible, and princely fortunes are well within the reach of capital and well directed energy. Electrical men, generally, have not been slow to realize this fact, and many leading American firms now have large contracts in the country, either completed or well on the way, and especially in lighting and power transmission. The use of the telephone is rapidly spreading, and the telegraph service has vastly improved in late years. There was a time when the monopoly vested in the Government telegraph service was shamefully abused. That, however, was before the present able executive had taken hold of the system. Incapacity and indifference pervaded the service, and the punctual forwarding or delivery of a message from a private individual was almost unheard of. A prominent contractor recently told the writer that at one time he paid $30 for the sending of a telegram from Zacatecas to Chihuahua, a distance of 560 miles, and the message was one month in reaching its destination. It was under such conditions as these that the Mexican Central Railway saw an excellent opening for at the same time building up a collateral source of revenue and conferring a benefit on the country in which it has so much at stake; and in 1880 it threw its telegraph lines open to the public. The system succeeded from the start. Even the easygoing Mexican recognized the value and convenience of being able to count on the prompt and efficient handling of his telegrams, and before the Government set about mending its ways, the Mexican Central system secured a grip on the public confidence that it has never lost, and it is now one of the most popular services in Mexico. It has an immense advantage in the fact that the points reached by it are not covered by the Government system, with the exception of Chihuahua, Zacatecas, Aguas Calientes, Guadalajara, Queretaro, and a few comparatively unimportant stations.

In this way, the Mexican Central service admirably supplements where it does not supersede, that of the Government; and that the public appreciate the benefits it offers is shown by the fact of its continuous increase of business. Thus during the last year 22,000 messages were sent, as against 15,000 in 1884 and 18,000 in 1886. The central office is in charge of Mr. J. E. Weber. It is prettily situated in the Plazuella de Guardiola, in the central portion of the city of Mexico. This office is devoted entirely to the transmission of commercial messages, the company's telegraph business being handled at Buena Vista, at the Mexico City terminus of the line. The other offices receive commercial in conjunction with railway business. The line is kept in good repair, and is overlooked by the telegraph inspector, Mr. G. R. Stanton, who makes periodical trips to the offices on the line.

Among the difficulties of maintenance with which the company has to contend one is of very unusual character. The line runs near El Salto along a remarkable canal called Nochistongo. This cut is in many respects without a parallel in history. As a matter of fact it was the attempt in the early Spanish days to accomplish what modern engineers are now engaged on, the placing of the city of Mexico beyond any possibility of being submerged by a flood. The land on which Mexico is built is only 6 feet higher than the lowest part of the valley. Lake Texcoco in its normal condition is lower than the city, but in flood time its waters may rise and sweep over the capital. The Nochistongo cut was to serve as a safety valve by drawing off the waters of the lake. It is 12 miles long, of an average depth of 180 feet and an average width of 400 feet.

Short stretches of the telegraph lines run along the cut and in certain places where the poles are placed on a rapidly sloping bank, the wires can be reached by a person of ordinary height. This affords the Mexican women an opportunity for an extempore clothes line that is too good to be allowed to pass. On Sunday mornings, which is about the only time the somewhat hardly treated family linen of the peon receives any attention from the laundress, travellers on the railway will be puzzled by the sight of festoons of dingy white garments strung along the wires, with a flecking here and there of the gaudy coloring of the street attire of the washerwoman or the zaripe of her lord and master. The effect is quite comical to everyone but the line inspector, who gets at white heat, and sends out an extra squad of watchmen to cover the points most exposed to the enemy. But still repair bills come high along Nochistongo.

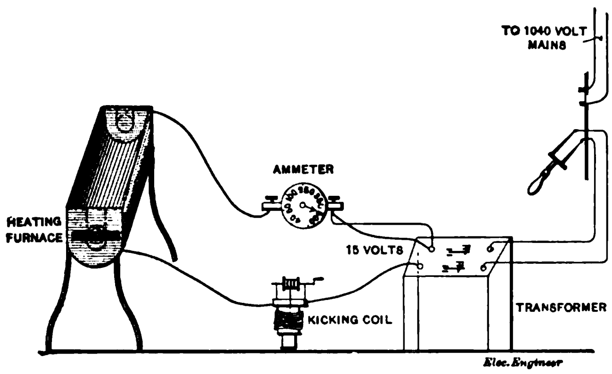
At Torreon communication is established with the Mexican International Railway, and telegrams reaching any point on the Mexican Central System, can be transmitted to any point on the Mexican International, extending from Durango, about 200 miles from the Pacific Coast, to Eagle Pass, Texas. This system not only intersects a large section of the country from north to south, but includes a cross section extending from Guadalajara on the west to Tampico on the Gulf of Mexico on the east. Since the recent assumption by Mr. H. R. Nickerson, of the general managership of the Mexican Central Railway, the operation of that system has been markedly Americanized, to the great satisfaction of the travelling public, and the reform thus inaugurated has been extended to the telegraph department, which has been merged into the passenger department. This step will, it is believed, contribute still further to the efficiency of the service and its value to the public.

A NOVEL ELECTRIC FURNACE FOR HEATING IRON STRIP.

THE variety of ways in which the electric current can be applied for heating purposes seems to be steadily on the increase. Thus the heat can be applied directly to the body by passing the current through it either by the direct current or by the alternating current as in Prof. Thomson's welding processes. It can also be subjected to the arc as in the Benardos and like processes. Again it can be heated under water as in the recently developed Hoho process; and finally the object to be heated can be brought into contact with another body previously heated by the passage of the current.

It is an application of the last mentioned kind that has

recently been made in Montreal, Canada, where the Montreal Electric Co., at the order of Messrs. Siemens Bros. & Co., have lately installed a furnace for heating iron strip



ELECTRIC FURNACE FOR IRON STRIP.

used in making horse-shoe nails, at the rolling mills of Messrs. Peck Benny & Co., Montreal.

The accompanying engraving shows the arrangement. The local lighting company's mains are run in and deliver current at 1040 volts alternating to the Siemens transformer which reduces it to 12½ or 15 volts as required. The secondary flexible cables pass through an ammeter built on the dynamometer principle, also through a kicking coil which has a movable core, and thence to the furnace.

The furnace consists of a carbon tube, 24 inches long, with a bore of 1 inch, and walls ½ an inch thick; the tube is covered over with sand. The current at 15 or 12½ volts passes through this tube bringing it to a white heat. 500 amperes is the usual current allowed, but at starting it is increased a little to hasten the heating up of the carbon which decreases its resistance, and the current is then lowered to normal. It is intended for continuous feed, and will heat five feet of strip per minute. There was some doubt that the heat could be got up, but this has been conclusively proved by the experimental apparatus described above.

ELECTRICAL MACHINIST PRACTICE.—XVII.

BY

James F. Hobart.

In attempting to operate an elevator with an electric motor for power, several peculiar requirements are met with. First, in the production of the screw or worm, a

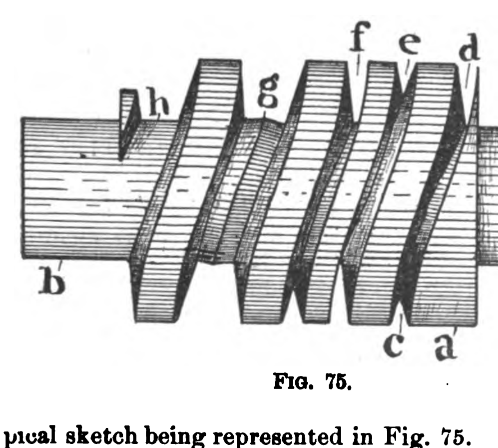


FIG. 75.

typical sketch being represented in Fig. 75. A completed thread is shown between *g* and *h*, and other threads in various stages of construction at *d*, *e*, and *f*. The worm blank is first to be turned up in the usual manner to the diameters shown at *b*, and *a*, respectively. Then, instead of commencing the work with a tool made to fit the space *g*, as is usually done in screw cutting, a cut is made as shown at *c*, *d*, with a narrow cutting-off tool. This cut is continued along the entire length of the worm, precisely as if cutting a thread with that tool alone. It must, however, be inclined so as to cut to the bevel of the tooth as shown at *d*. After completing the first cut, set the tool to an incline in the opposite direction and make the cut *e*. The tool should be fed in until the three-cornered piece *e*, *f*, becomes separated from the body of the worm. If the cutting be well done, the triangular spiral of steel can be easily removed by unscrewing it out of the worm thread.

After the spiral has been removed, a square-end tool should be used—one wide enough to just go in between the teeth is preferable—then the bottom of the thread can be cleaned up as shown at *h*, and the exact desired diameter of *b*, obtained at the same time. If the tool used at *h* be of the exact width desired at the bottom of the thread, the cut thus made may be used as a guide for dressing up the sides of the thread. The sides must necessarily be somewhat rough after being cut down with a cutting off tool, and need to be dressed up both to size and to a finish.

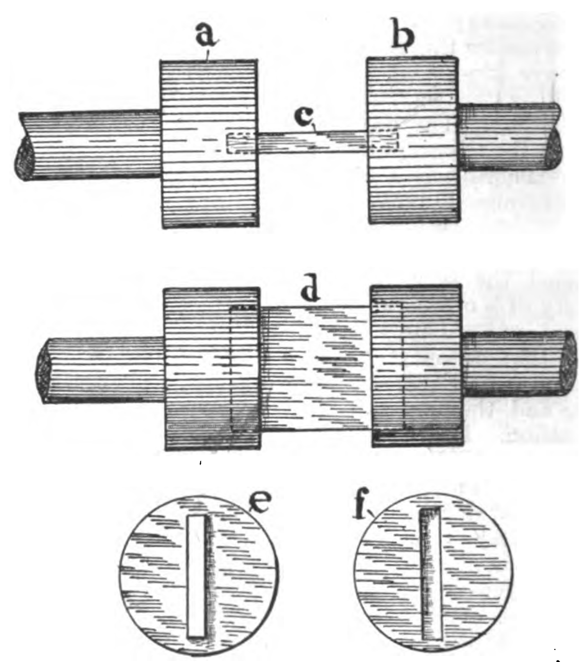


FIG. 76.

A side tool will do this work well; set it to the desired angle by means of a gauge or templet, then cut boldly down the side of the thread until it is *straight*, from top to bottom, and of the right width at both extremities. If the side tool be carefully used, there will be nothing more to be done to the worm, except to smooth the corners a little with a file. A "water cut" should be used in finishing both sides and bottom of the threads, and, if an extra nice piece of work is desired, a small emery wheel can be mounted on the tool post, and the work ground to the degree of nicety desired.

The matter of connecting a motor and an elevator is not so simple a problem as it appears to be at first sight; no matter how exactly the two shafts may be placed in line, their rate of wear is different and they will not stay in alignment. To begin with, it is quite difficult to put a motor and another machine exactly in line axially. In order to make sure of the two machines being in line *exactly*, they must both be made at the same time. They must be both planed off and bolted to a solid base and the bearings all bored out while the machines are thus bolted rigidly in line. Or, the work may be done by first boring out the bearings, mounting

the two machines upon a stiff arbor, and then planing off the base. This method is usually employed in fitting the head and tail stocks of lathes. In this case, the two parts *must* be in exact alignment, or the machine will be valueless for the purpose for which it is intended. Most electric elevator builders take the safe ground that the worm shaft and the armature are *not* in line, no matter how carefully they may have been fitted, on the assumption that if placed in line at the beginning, (which they consider doubtful) the machines will not stay in line after running a while. Thus considering that the machines are out of line, some flexible connection between them is necessary. A form of universal coupling has been used, but this piece of mechanism is complicated, costly, and much more elaborate than the requirements demand.

The electric elevator builders have taken a good lesson from the rolling mill, and adopted a modification of the connection used there, between trains of rolls. Instead of the connecting piece having a cross-shaped section, a plain piece of steel is used as shown in Fig. 76, at *c* and *d*. The flanges *a* and *b*, are built upon the ends of the worm and armature shafts respectively. Both face plates, on flanges are mortised as shown by the dotted lines. The flange *a*, is mortised to fit the plate *c* quite snugly. Flange *b*, fits it snugly sidewise, or flatwise as shown at *a*, but the mortise is longer than the plate is wide, as shown at *b*. This construction which is a very important one, is more plainly shown at *e* and *f*. At *e*, the plate is shown fitted snugly into the flange. At *f*, the mortise to receive the other end of the plate, is shown. This apparatus will not work well when there is excessive "out of truth" between the motor and elevator, but for slight variations, it leaves nothing to be desired. It would be well for electric elevator builders to seriously consider the matter of cutting the worm directly upon the armature shaft, thus doing away with couplings and universal joints entirely. But three bearings would then be necessary where four must now be used, and everything could then be bored out in line, once for all.

ALTERNATING CURRENTS.[1]

BY PROF. E. J. HOUSTON, PH. D. & A. E. KENNELLY, F. R. A. S.

From what has been said concerning the nature of simple-harmonic motion generally, it is evident that in sinusoidal current circuits we have to deal with quantities which are varying with time according to the projection, on a line, of circular motion in a plane, as represented, for example, in Fig. 106. It is, therefore, of importance, in considering such circuits to bear in mind the relation of geometrical magnitudes, as opposed to simple arithmetical magnitudes; that is to say, that not only the magnitudes of the various E. M. F.'s and currents have to be considered, but also their directions at different instants of time. For example, if two similar sinusoidal alternators be rigidly connected on the same shaft, and coupled in series,

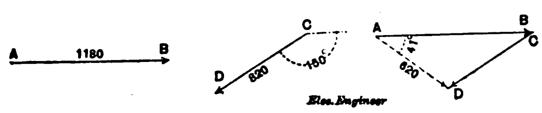


FIG. 106.

the E. M. F. of each will have the same frequency and the same magnitude. Their resultant E. M. F. when connected in series, will depend upon the exact relative position of the two armatures to each other on the common shaft; that is, upon the relative phase of the E. M. F.'s and whether these are in-step or out-of-step with each other. If they are exactly *in-step*, that is, coupled in the *same phase*, so that the two waves of E. M. F. are synchronous, or rising and falling exactly together, the resultant E. M. F. of the combination will be the simple arithmetical sum, or twice the E. M. F. of either, and in-step with each, so that if each gives separately 1000 volts effective E. M. F. at a frequency of 120, ~ the two so connected will give in series a total E. M. F. of 2000 volts effective, with, of course, the same frequency. If, however, the two machines are coupled in exactly *opposite phase*, so that while one develops the positive crest of a wave, the other develops a negative crest, so that the

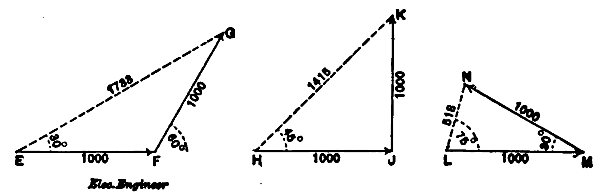


FIG. 107.

difference of phase is 180°, or half a cycle between them, then their E. M. F.'s at all moments are oppositely directed, and the total E. M. F. of the combination will be zero, since in all parts of the wave, the E. M. F. of the one will exactly neutralize that of the other. At intermediate positions of coupling, or phase difference, the resultant E. M. F. will vary between 2000 volts and zero, and the phase of the resultant E. M. F. will also vary.

This resultant E. M. F. can be very simply determined by considering each E M. F. as a line, or *plane vector*, revolving about one extremity, and making as many revolutions per second as there are periods per second in the frequency. Thus, let A B, Fig. 106, represent a sinusoidal E. M. F. of 1180 volts effective, and suppose that this line revolves counter-clockwise in the plane of the paper, about the centre A, 120 times in a second. At the moment when A B, is in the position shown, let a second sinusoidal E. M. F. of 820 volts effective, C D, of the same frequency, but having a phase 150°, or $\frac{5}{12}$ of a cycle in rear of A B, as shown by the direction of the line C D; then the resultant, or sum of these two sinusoidal E. M. F.'s, when connected in series, is represented in direction and magnitude by the line A D, for C D is here added geometrically to A B. The line A D, has a length of 620 volts, according to the original scale, and makes an angle of approximately 41° with A B, so that the resultant E. M. F. of the combination will be 620 volts effective, lagging in phase 41° behind A B, or advancing in phase 109° beyond C D.

If two similar sinusoidal alternators be coupled in series, as shown in Fig. 107, so that one E. M. F., F G, leads the other, E F, by 60°, or $\frac{1}{6}$ cycle, then the sum of these two E. M. F.'s in series will be 1,733 volts effective, 33° ahead of E F. Again, if they be connected in *quadrature*, that is, at quarter phase, so that J K, leads H J by 90°, their sum in series will be 1,415 volts, 45°, or $\frac{1}{8}$ period, beyond H J, and behind J K; and again, if the phase difference amounts to 150°, so that M N, makes 30° with L M, their sum in series will be L N or 518 volts effective, 75° in advance of L M.

The current strength in an alternating current circuit is not that which would be immediately obtained at first sight from Ohm's law. Ohm's law applies to alternating current circuits when the C. E. M. F.'s in the circuit are considered; but without taking the pains to determine what the C. E. M. F.'s become in an alternating circuit, we may consider that the impressed E. M. F.'s, that is, the E. M. F.'s produced by the source or sources, are alone operative, and that the resistance of an alternating-current circuit is different from that of the same circuit operated by continuous currents; or, in other words, that the resistance becomes converted into a hypothetical quantity called the *impedance*, and expressible in ohms. Ohm's law applied to alternating current circuits is, therefore,

1. No. 31. Intermediate Grade, of Houston & Kennelly's *Electrical Engineering Leaflets*.

$$I = \frac{E}{J} \text{ amperes, instead of } I = \frac{E}{R} \text{ amperes,}$$

where J, is the impedance.

There are two quantities which combine with resistance to make up the apparent resistance or impedance of alternating-current circuits, namely:

(1) Inductance, as typically developed in *choking coils* and which is always present in greater or less degree;

(2) Electrostatic capacity, as typically developed in *condensers*, and which in some circuits is almost entirely absent, but at other times exists in a marked degree.

If we suppose that a coil of insulated copper wire has a resistance of 10 ohms and an inductance, i. e., a self-induction of 0.015 henry, and that a sinusoidal E. M. F. of 52 volts at a frequency of 100 ~ is impressed on this coil, then, since no appreciable electrostatic capacity exists in the circuit, the impedance is composed of two parts; viz., of the resistance, and of a quantity called the *reactance*, due to the inductance of the coil. This reactance is determined by multiplying the inductance by the angular velocity of the E. M. F. The angular velocity in this case is 100 revolutions per second, and, since there are 2 π radians in a revolution, 200 π, or 628.3 radians, per second. Multiplying this angular velocity by the inductance in henrys, we obtain the reactance: $628.3 \times 0.015 = 9.425$ ohms. The reactance is always graphically set off at right angles to the resistance of a circuit, the inductance-reactance being set off above the line. Thus $a\ b$, Fig. 108, having a resistance of 10 ohms, the reactance $b\ c$, 9.425 ohms, is laid off above the line $a\ b$, and the impedance, which is always the geometrical sum of the resistance and reactance, is equal to the length of the line $a\ c$, joining a and c, or 13.74 ohms. If we divide this impedance into the pressure, according to the modified form of Ohm's law before stated, we have $\frac{52}{13.74} = 3.785$ amperes, the effective current strength.

The reactance of a condenser is equal to the reciprocal of the product of the angular velocity of the E. M. F. by its capacity in farads. Thus, if a 10 microfarad condenser be connected directly across the terminals of an alternator, supplying 1100 volts effective, at a frequency of 100 ~, the angular velocity will be 628.3 radians per second as before, and the product of this by 10 millionths of a farad will be (Fig. 109) $\frac{6283}{1,000,000} = 0.006283$. The reciprocal of this quantity or $\frac{1}{0.006283} = 159.2$ ohms, and the current passing into the condenser will be, by the modified form of Ohm's law, $\frac{1100}{159.2} = 6.91$ amperes effective.

If the condenser instead of being connected directly

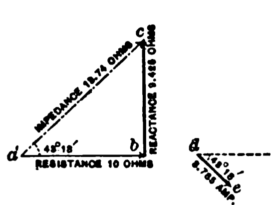


FIG. 108.

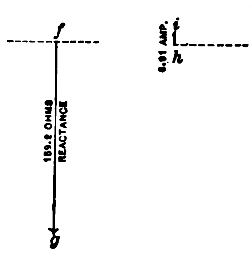


FIG. 109.

across the terminals of the alternator were in series with a resistance coil of 50 ohms, having an inductance of 0.02 henry, then it is necessary to determine the impedance of a circuit composed of resistance, inductance and capacity combined. The reactance in this case will be partly due to inductance and partly due to capacity. The inductance-reactance will be $0.02 \times 628.3 = 125.7$ ohms, and the capacity-reactance will be, as before, 159.2 ohms; but, while inductance-reactance is always laid off above the resistance line, capacity-reactance is always laid off below the resistance line, or in the opposite direction, because capacity and inductance tend to neutralize each other's influence. The resultant reactance in this case, as shown in Fig. 110, or 33.5 ohms, will, therefore, be directed downwards, and the impedance of the circuit will be 50 ohms of resistance plus 33.5 ohms of

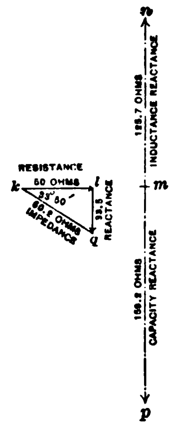


FIG. 110.

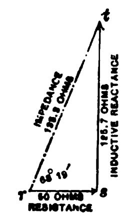


FIG. 111.

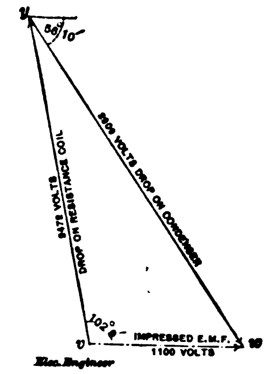


FIG. 112.

reactance = 60.2 ohms of impedance, so that the current strength passing through the circuit from an alternator, maintaining 1100 volts effective at its terminals, will be $\frac{1100}{60.2} = 18.27$ amperes, which is seen to be nearly three times as much as if the condenser had been connected directly with the alternator.

In a continuous-current circuit, the drop at the terminals of any resistance R ohms, traversed by a current I amperes, is $I\ R$, volts; so, in an alternating current circuit, the drop at the terminals of any impedance J ohms, traversed by a current of I amperes effective, is $I J$ volts. The condenser has in this case a reactance by itself of 159.2 ohms, which, in the absence of inductance or resistance, becomes the impedance J, of the condenser. The current strength I, is 18.27 amperes, and the drop on the condenser $I J$, is $18.27 \times 159.2 = 2909$ volts. If the inductance-reactance of 125.7 ohms could be separated from its accompanying resistance in the coil, the drop on the resistance itself would be $18.27 \times 50 = 913.5$ volts; but, since the inductance and resistance of a coil of wire cannot be separated, all that can be observed is the drop at the terminals of the two coils; namely, at the terminals of the 135.3 ohms impedance, as represented in Fig. 111, and in this case the pressure at the terminals of the resistance would be $18.27 \times 135.3 = 2472$ volts. It follows, therefore, that a sinusoidal effective E. M. F. of 1100 volts, which never exceeds 1555 volts at the peak of the waves, can produce a pressure that could be measured with a suitable voltmeter, of 2472 volts across the terminals of the resistance coil, and a further pressure in series with this of 2909 volts across the terminals of the condenser, making a total pressure arithmetically of 5381 volts; but geometrically the sum of these two pressures can only be 1100 volts, because the impressed E. M. F., as shown in Fig. 112, is out of phase with the C. E. M. F.'s.

SYLLABUS.

When two sinusoidal E. M. F.'s are connected in series their resultant will be their geometrical sum.

LABORATORY OF HOUSTON & KENNELLY,
PHILADELPHIA.

A PHILADELPHIA MUNICIPAL PLANT.

A resolution has been adopted by the Philadelphia Common Council requesting information relative to a 400 arc light plant for the city.

THE YARMOUTH, (ENG.) ELECTRICITY WORKS [1]

A favorite and attractive watering-place during the season, but dull and dreary in winter time, are the conclusions arrived at by the occasional visitor in regard to what is sometimes termed "bloater land." Yarmouth, it is scarcely necessary to mention, derives its name from the fact that it is situated at the mouth of the Yare, about 20 miles from Norwich; and its population comprises some 50,000 inhabitants, this number including those persons living on the other side of the river in Gorleston and Southtown, which form part of the borough. The latter covers an area of 4,500 acres.

The lighting system comprises high-pressure alternating-current generators with transformer stations for incandescent lighting, and direct-current series machines for street illumination by means of arc lamps. The town is of a straggling character, with a portion of the borough on each side of the river. The site chosen for the station is Corporation land in the South Denes-road, about 1½ miles from the Hall Quay, or centre of the town. Here supplies of coal are readily obtainable, whilst water for condensing purposes is obtained from the river adjoining.

An idea of the general arrangement of the station, which is capable of being considerably extended, will be gathered from the cross-section Fig. 1.

The boiler-house, which is arranged 4ft. 6in. below the level of the engine and dynamo room, contains two watertube boilers of the Babcock and Wilcox type, constructed for a working pressure of 150 lb. Each boiler is capable, with the feed water at 60 deg. F., of evaporating 4,500 lb. of water per hour. These boilers are provided with a feed water ring main 8in. in diameter, and with a duplicate feed to each boiler, so that the pumps can supply either one or both boilers, and the security of the feed is effected.

There are two feed pumps of the Worthington duplex type, each capable of delivering 2,500 gallons of water per hour. Outside the station are arranged two water-tanks having a total capacity of 9,000 gallons. These tanks are filled from the town mains by means of a donkey pump and the water is drawn from them by the pumps.

The ring system of steam distribution which has met with considerable favor in central station work, has been introduced, together with an auxiliary steam ring main for use when necessary. The boilers deliver from their connecting pipes into the main steam ring, which is carried through the wall of the boiler house into the engine-room, and from there the branch pipes are taken off to the engines. The ring main is of wrought iron 6in. in diameter, and the bends and branches to the engines are of copper. The water is then either pumped into the boilers direct or is forced through the tubes of a Green economizer, and thence passed into the feed-water ring main. This economizer consists of 192 tubes arranged in two groups fitted with expansion elbows, and provided with space between the pipes and the wall, thus facilitating examination, and giving access to all parts. The machine is constructed from new patterns to withstand the boiler pressure of 150 lbs. per square inch, all portions subjected to internal pressure being considerably strengthened.

As in the case of Bristol and Bedford, and as is now being specified for other towns, so also at Yarmouth has a gas engine alternator been erected for dealing economically with the demand for light on the part of private consumers during the day and late at night, when the lighting requirements do not

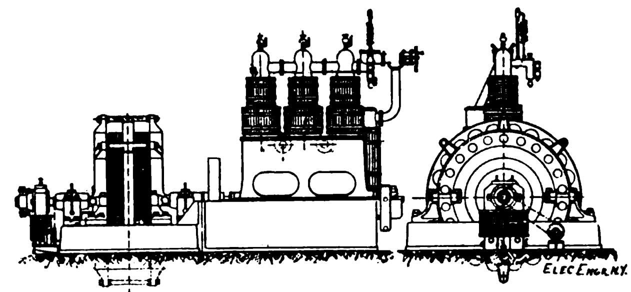


FIG. 2.—COMBINED ENGINE, ALTERNATOR AND EXCITER.

necessitate the continued working of the large machines. In this case the method of driving is by means of belt.

The gas engine is of the Crossley type, capable of indicating 83 H. P., running at 200 revolutions, and driving, by means of a belt, a 15-kilowatt Crompton-Brunton alternator direct coupled to its exciter. The engine is fitted with heavy fly wheels and special governor so as to ensure steady driving, and the alternator gives 7.5 amperes at 2,100 volts.

There are two sets of arc light machinery. Each set comprises an engine driving two dynamos set back-to-back. These engines are of the Willans F F compound type, arranged with independent outer plummer-boxes and pulleys for driving the arc light dynamos by means of ropes. The engines, which run at 450 revolutions a minute, each actuate two arc machines, the speed

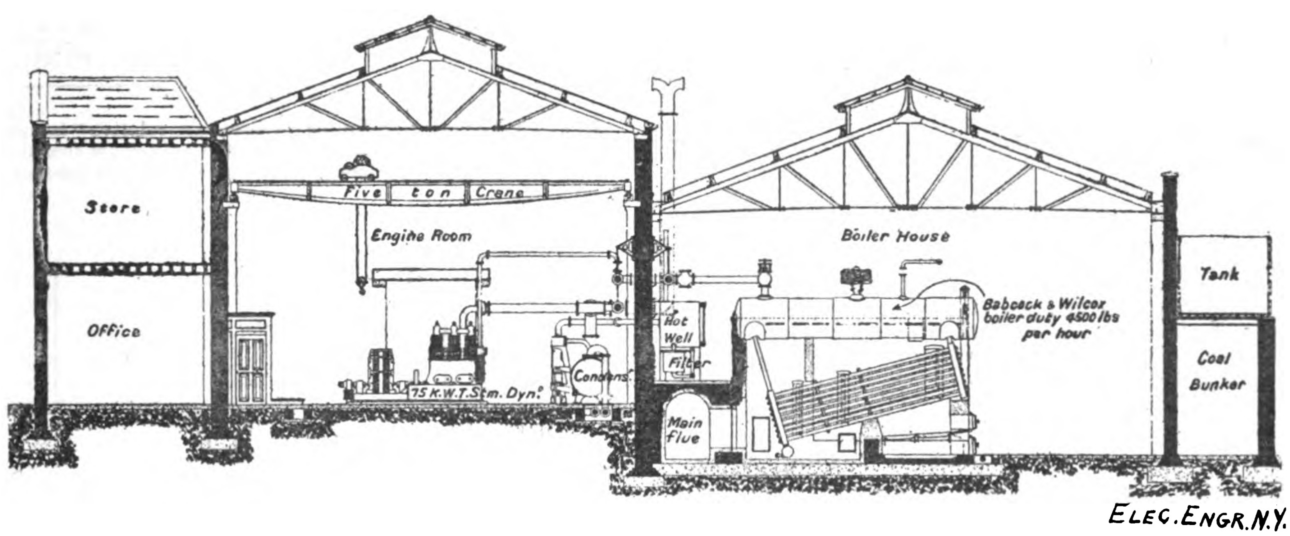


FIG. 1.—THE YARMOUTH (ENG.) ELECTRICITY WORKS.—CROSS SECTION.

The main exhaust-pipe, which is of cast iron, is 12in. in diameter, and is normally connected direct to the condenser. When the latter is not at work the exhaust steam is allowed to pass into the atmosphere through a 10in. pipe, as indicated on the plan. When, however, the condenser is in operation the valves between the exhaust-main and the exhaust-pipe to atmosphere are closed, and the condensed steam from the engines and condenser passes into the hot-well, as shown.

The condensing plant comprises a surface condenser having a tube surface of 600 square feet, and an air and circulating pump. The suction and discharge pipes of the circulating pump are connected with the river, and the air-pump with the condenser.

To remove the oil gathered in the engines, the water from the hot well is passed into a filter, from which it is drawn by either of the pumps, or, if necessary, the filter can be disconnected. The

of which is 830 revolutions. These dynamos are of the Crompton type, series wound, and as each gives 10 amperes at 1,590 volts, it is capable of energizing 30 2,000 C. P. lamps.

In the case of the plant for incandescent lighting, the method of direct driving has been adopted for the triple combination of engine, alternator, and exciter. There are two such combinations, Fig. 2, and the periodicity of the alternators, which are, of course, arranged for parallel working, is 83.5 per second.

The engines are of the Willans G G G S compound type, arranged upon special bases. The speed of each engine is 460 revolutions per minute, and each is capable of developing from 130 to 140 effective horse-power.

The Crompton-Brunton alternators, each of which gives 36 amperes at 2,100 volts, have revolving disc armatures, the coils of which can readily be replaced at any time that occasion may arise.

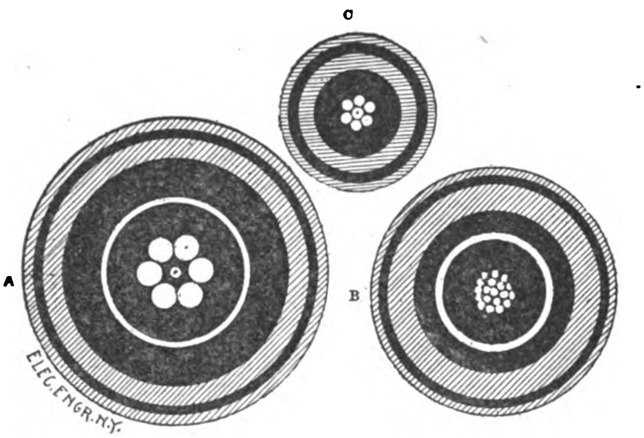
The switchboard, which is arranged on one side of the engine

1. Abstract from the London *Electrical Engineer*.

and dynamo room, is built up of slate panels, and is of Messrs. Crompton's usual type. A separate panel is provided for each alternator, each feeder circuit, and each exciter circuit, and one is arranged for the synchronizer and pilot-wire voltmeters. Spare panels are available for additional machines.

The work of supplying and laying the mains, boxes, and connections was entrusted to the British Insulated Wire Company, Limited, of Prescot. Paper-insulated and lead covered cables are used throughout, the mains being armored with steel strip, and laid direct in the ground. The section marked A, Fig. 3, is a high-pressure cable $\frac{5}{8}$'s in the core, with a pilot wire in the centre and one on the outers of cables; B is a $\frac{19}{8}$ double concentric high-pressure cable; and C is a section of the arc light $\frac{7}{16}$ high-pressure single cable, of which nearly ten miles have been supplied. All these cables were tested to 10,000 volts before being sent from the works, and were tested to 4,000 volts at Yarmouth. The low-pressure distributing mains are twin armored cables, .1 in. square section, and each house-box is made to serve two consumers. These mains were subjected to a pressure of 5,000 volts when connected. At present there are two arc light circuits taken from the station to the arc lamps in the town. In addition to this, an alternating circuit is provided for some alternating-current arc lamps.

There are two feeder mains for the incandescent lighting, which are taken to four transformer-chambers built under the pavement. Two of these sub-stations each contain a Crompton transformer of 25 kilowatts capacity, space being available for



A. Section of High-Pressure Double-Concentric Lead-Covered Armored Cable with Paper Insulation. B. Section of High-Pressure Double-Concentric $\frac{19}{8}$'s Armored Cable. C. Section of $\frac{7}{16}$ Single High-Pressure Cable.

FIG. 3.

the accommodation of an additional converter of the same output. In each of the other two sub-stations is arranged a 15-kilowatt transformer of the same type, there being spare room also in this case. The reduction is from 2,000 volts to 102 volts, at which pressure the electrical energy is supplied to consumers.

As far as the public lighting is concerned, there are 50 10-ampere direct and 10 15-ampere alternating current lamps of the Crompton-Pochin type.

The total capacity of the station for incandescent lighting is 5,000 8 C. P. lamps installed, or 3,000 simultaneously alight. Already some 1,500 lamps have been applied for, whilst including the lighting of the Municipal Buildings and the Fish Wharf, this number is increased to 2,500 lamps. Apart from this, further applications for a supply are constantly being received, so that it is probable that the output of the generating station will before long all be taken up.

ENGLISH ELECTRIC LIGHTING STATISTICS.

The London *Electrician* in its first issue of the year publishes some most interesting statistics showing the actual condition of electric lighting in England.

The map Fig. 1, shows the location and indicates the character of the lighting in the various towns of the United Kingdom.

In London the Metropolitan Electric Supply Company is, *facile princeps* so far as its lamp connections are concerned, its total of 206,000 being followed at a respectful distance by the 168,500 lamps of the Westminster Electric Supply Corporation, and then by the 136,000 of the City of London Electric Lighting Company.

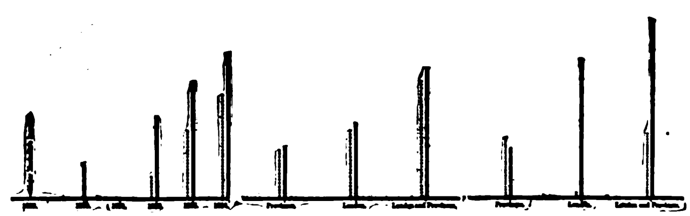
In Fig. 2 the vertical columns show total lamp connections for the United Kingdom. At the end of 1894 there was a grand total "lampage" in London and the Provinces of close upon 1,600,000, as against 1,125,000 for the end of 1893. The present totals for London and the provinces are respectively 925,000 and 670,000.

In Fig. 3 the vertical columns represent the relative "lampages" of alternate-current and continuous-current systems. It is interesting to note how closely these two rival methods of distributon run each other. The totals are set out in the tables below :—

FIG. 1.—ELECTRIC SUPPLY STATIONS OF THE UNITED KINGDOM.

	~	—
London	458,200	466,900
Provinces	321,000	348,800
Total	779,200	815,700

In Fig. 4 the vertical columns represent the relative "lampages" of municipalities and of companies, and clearly show that in spite of present day municipalizing tendencies by far the greater part



FIGS. 2, 3 AND 4.

of the electric lighting of the United Kingdom is still in the hands of companies; a result, says our contemporary, for which, however, we have only London to thank. The totals are set out in the table below :

—	Municipalities.	Companies.
London	38,000	887,100
Provinces	368,200	301,600
Total	406,200	1,188,700

BOSTON, MASS.—The New England Telephone Co. has adopted the system now prevalent in New York of grading rates, if the subscriber so elect, according to the service rendered, on the basis of a given number of calls. The full flat rate for unlimited service is $180 per annum.

THE MUNICIPAL LIGHTING PLANT OF SOUTH NORWALK, CONN.

ONE of the most interesting and successful municipal lighting plants in this country is that operated by the busy little city of South Norwalk, Conn. We believe that the accompanying illustrated description will be appreciated by many of our readers, whatever their prejudices or opinions on the question of municipal ownership.

The station building, Fig. 1, is a substantial brick, fire-proof

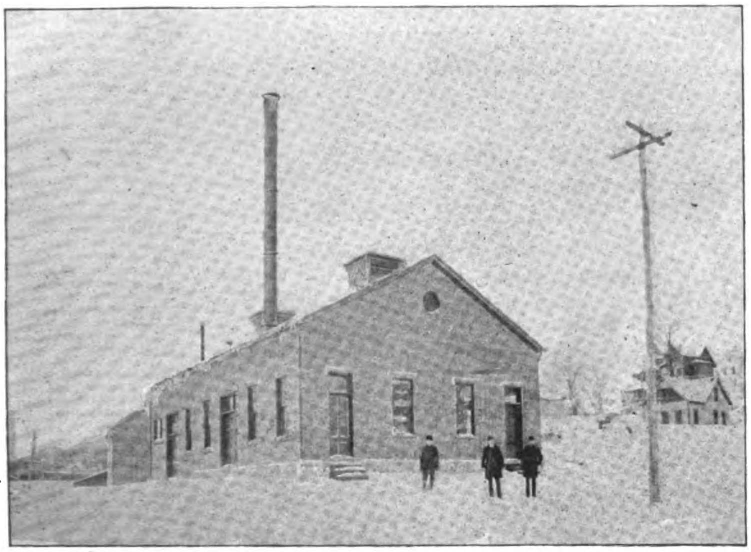


FIG. 1.—MUNICIPAL ELECTRIC LIGHT PLANT, NORWALK, CONN.

structure, with a slate roof, on which are two cupolas, one near the front to ventilate the engine room and receive the circuits, the other one near the rear to ventilate the boiler room. The station is one story high and of rectangular form, fronting 40 feet on State street and extending back 66 feet. The interior is divided by a brick fire-wall into an engine and dynamo room 38 by 30 feet, and a boiler and fuel room 38 by 25 feet 4 inches. This room contains a 125 H. P. horizontantal tubular boiler, 6 feet in diameter by 16 feet long, set with a Weitmeyer patent furnace to economize in fuel, an iron smokestack 33 inches in diameter by 70 feet high, a 200 H. P. feed water heater, a 200 H. P. injector, a 1-inch fire hose, 60 feet long, and storage space for about 60 tons of coal. An automatic damper regulator controls the draught.

The engine room, Fig. 2, contains a 100 H. P. Ideal automatic high speed engine, with two driving wheels five feet in diameter, making 300 revolutions per minute, which are belted direct to two Western Electric Company's dynamos of 60 arc lamps capacity each, with automatic regulators. Each dynamo is provided with switches, by the use of which the lamps can instantly be burned at 1,200, 1,600 or 2,000 C. P. In this room are also all necessary electrical testing and regulating apparatus, an extra armature, and a feed water pump for 200 H. P., and a fire alarm call-box and gong. On a gallery at the front end of the room are located all batteries and apparatus for operating the entire fire alarm system of the city. The electrical plant was furnished by the Western Electric Co., the steam plant by W. R. Fleming & Co.

Both boiler and engine rooms have large double doors on the outside through which the largest machinery may be taken. A large sliding door gives access from engine room to boiler room. The office and store room each have a separate door opening into the engine room and separate outside front doors. Both engine and boiler rooms are also arranged so that the capacity of the station can be doubled without any alterations. All steam, exhaust and feed piping is double the size required at present, and the front and rear walls of the station are built so that they may be extended to the full length of the lot without interfering with the present arrangement. Thus the station can be increased at least 500 per cent. Provision is also made for a brick smoke-stack of 500 H. P. capacity. The floor in the boiler room is of brick laid on edge; all the rest is of concrete. Two electrical circuits leave the cupola, supplying ninety-nine arc lamps, distributed about the city streets and municipal buildings, containing about fifteen miles of wire. Most of the lamps are suspended across intersecting streets; the rest are either on mast-arms or pole-tops.

The executive force consists of three electric light commissioners elected by the people, each one serving a term of three years, one new commissioner being elected at each annual election. Their titles are chairman, secretary and consulting engineer. It is their duty to have charge of and maintain the electric light and fire alarm systems.

The operating force consists of a superintendent, engineer and lineman, who are appointed by the electric light commissioners.

The results reached last year in the operation of the plant are given as follows:

Capacity of plant in 2,000 candle power lamps	120
Number of circuits	2
Miles of wire in circuits, about	15
Average distance between lamps in feet	500
Average lamps in service during year	98
Average candle power per lamp	1,400
Average number nights lighted during year	309
Average cost per lamp per night, (interest and depreciation included)	\$ .18 7/10
Average cost per lamp per night, (interest and depreciation excluded)	.19 3/10
Average cost per lamp per year, (interest and depreciation included)	\$59.29 3/10
Average cost per lamp per year (last report)	64.58 1/4
Average pounds of coal per night	2,282.5
Average pounds of coal per night per light	23.29
Average pints of cylinder oil per night	1.68
Average pints of engine oil per night	.75
Average pints of dynamo oil per night	.37

Lighting is started at dusk and stopped between 1.30 and 2 a. m. On special occasions, such as the Fourth of July night, and other times if deemed advisable for the city's safety, the lamps are burned till daylight. The standard moon light schedule is not strictly followed, but on cloudless nights when the moon is sufficiently bright to properly illuminate the streets, the lamps are not burned; however, if the moon is obscured by clouds the lamps are burned as usual. This method after two years' trial has proved very satisfactory, and also considerably diminishes the operating expenses. The Western Electric lamps are automatic in adjustment, and can at will be instantly made to produce 1,200, 1,600 or 2,000 candle power. It may be stated that, roughly figured, there is an average of one street light to each sixty inhabitants of the city; and at that ratio the cost to each person for the year's lighting is only 97 cents.

A new and important means of reducing the cost of fuel, has been adopted after a satisfactory trial. The item of fuel is one of the heaviest expenses of a steam electric generating plant, and every possible method is employed to get the greatest amount of work from the smallest outlay in coal. The means with this end in view, which has been adopted, consists in mixing locomotive sparks with first class bituminous coal, in quantities of one part sparks to two parts coal, which produces a fine composite fuel that burns readily in the furnace. These sparks, which heretofore were supposed to have no other function than to get in the eyes of unfortunate passengers, are particles of coke which are

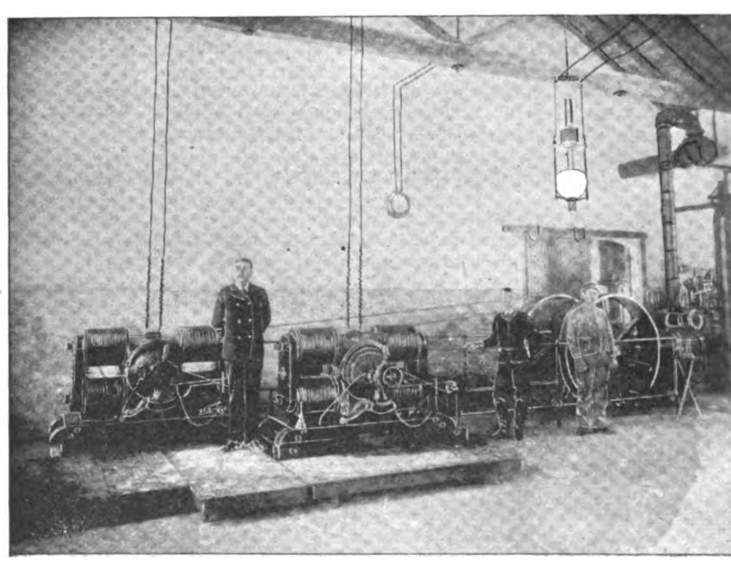


FIG. 2.—ENGINE AND DYNAMO ROOM, NORWALK MUNICIPAL PLANT.

collected in the smoke arch of locomotives. They are bought from the N. Y., N. H. & H. R. R. in car loads at very low rates in comparison to coal, and by their use the cost of coal is greatly reduced.

The plant is managed by an unpartisan board, composed of Messrs. Leslie Smith, J. A. Volk and A. E. Winchester. The latter is well known in electrical engineering circles as an expert of ability. He superintended the design and installation of the plant, and may be said to act still as its consulting engineer, a fact which helps explain the high efficiency

reached. None of these gentlemen is under a salary, their emolument consisting in such small gratuity as the City Council may vote them. The paid superintendent is Mr. William Bonnel. Commissioner Volk is a young business man, who is manager of a hat company. Col. Smith is a retired officer of the U. S. Army, of middle age. Mr. Winchester was with the Edison and General Electric Co's. as a protegé and pupil of Mr. J. H. Vail, and has spent his professional career in the design and construction of lighting and railway plants. Each commissioner serves three years.

THE BEST METAL FOR STEEL MAGNET FRAMES.[1]

BY ALTON D. ADAMS.

The cost of cast-steel is fully equal to that of forgings in simple shapes, and as it lies between cast and wrought-iron in magnetic qualities, the cost of machines made with it will be between those of cast and wrought-iron. A comparison will, therefore, be made between the cost of the latter two.

Taking wrought-iron at a saturation of 90,000 and cast at 40,000 lines per square inch, the section of an equivalent cast will be two and one-quarter times that of a wrought frame, and as the length of the cast-iron frame must be a little greater to give enough winding length, its weight will be about two and one-half the wrought. A saving is thus at once made in favor of the wrought magnet, as forgings can be had per pound for much less than two and one-half times the cost of cast-iron.

The same number of ampere-turns and watts being required for the coils of the cast as for the wrought-iron magnet, and the weight of wire varying as the square of its length, the coils for the cast-iron frame will be much heavier. The armature core may have the same diameter in each frame, but must be longer in the cast frame so as to come under the pole pieces, thus materially increasing its weight. As for the same resistance, the weight of armature winding increases as the square of its length, considerable more wire is required for the armature core of the cast-iron machine. In addition, the purely mechanical parts, shaft and base, must be larger and more costly in the cast-iron machine because of the greater weights they have to carry.

To illustrate the difference in cost of construction, the following data of two machines is presented, each having capacity of 25 K. W. of 1,275 revolutions per minute, the same winding losses, the same ampere-turns on armatures and field ampere-turns in air-gaps equal to about twice the armature ampere-turns active at the pole corners.

The air-gaps and armature cores of each machine are crossed by 4,320,000 magnetic lines, and allowing a leakage of 25 per cent. the field core must furnish 5,760,000 lines. A wrought-iron field to carry 5,760,000 lines, at 90,000 per inch saturation, requires a section of 64 square inches, which is provided by a core of 8 inches square and a cast-iron field at 40,000 lines per square inch requires a section of 144 square inches provided by a core 12 inches square.

Allowing sufficient length for magnet winding, the same air-gap resistance and an armature core of 11 inches diameter for each of these frames, the weights of these frames are

Wrought-iron frame	1020 lbs
Cast-iron frame	2780 "

For work as shunt motors the wrought-iron machine requires 11,330 ampere-turns in the air-gaps and 2,000 in iron, the cast machine 11,000 ampere turns in air-gaps and 3,800 in iron.

With 440 watts expended in field coils of each machine, average length per turn of 38 inches in the coils for wrought iron and 54 in. in the coils for cast iron, the weights of these coils are

Wrought-iron machine	133 lbs. copper.
Cast-iron machine	340 " "

The drum armature for the wrought frame is 11 inches diameter and 8 inches long, that for the cast frame 11 inches diameter and 12 inches long, without allowance for shaft hole.

The weights for armatures are

Wrought-iron machine	211 lbs. discs.
Cast-iron machine	316 " "

With a loss at full load of 490 watts in the armature winding for wrought-iron machine, and 464 watts in the armature winding for cast-iron machine, these windings require in

Wrought-iron machine	49 lbs. copper.
Cast-iron machine	71 " "

The above indicates plainly the great saving of wrought over cast-iron in dynamo construction.

From the users' standpoint the wrought-iron machine seems preferable on account of its lesser weight and bulk, this difference being especially marked in machines for direct connection of engines, and other purposes where slow speed is necessary.

1. Abstract of a paper read before the American Institute of Electrical Engineers, January 16, 1895.

THE COST OF GERMAN INCANDESCENT LAMPS.

In the *Zeitschrift fuer Beleuchtungswesen*, Mr. E. A. Krueger gives the following estimate of the cost of manufacture of incandescent lamps in Germany, based on actual experience:

Material.		
Glass Bulb	.04 Mark.	
Platinum	.08 "	
Filament	0.02 "	
Terminals and Plaster	0.02 "	
Glass stem and exhausting tube	0.015 "	
		0.175 M.
Wages.		
Manufacture and Preparation of Filament	0.02 Mark.	
Preparing the Leading-in Wires	0.01 "	
Fastening Filament to Leading-in Wires	0.008 "	
Cementing Carbon and Sealing in the Exhaust Tube	0.025 "	
Exhausting, etc	0.025 "	
Photometering	0.01 "	
Putting in Socket and Soldering Wires Thereto	0.02 "	
Cleaning and Etching	0.01 "	
		0.125 M.
Operating Expenses.		
General Expenses	0.02 Mark.	
Current	0.02 "	
Gas	0.005 "	
		0.045 M.
Losses.		
Loss by breakage of finished lamps (10%)	0.0345 Mark.	
		0.0345 M.
Grand Total		0.3725 M.

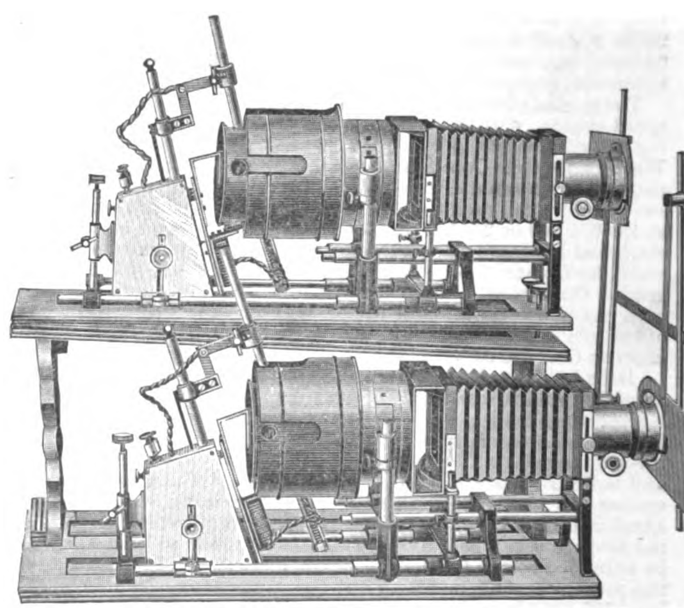
To this figure must be added the cost for shipping, heating and illumination of factory, rent, salaries, depreciation, interest on capital invested, so that the price of the lamp would probably be increased to 0.45 Mark, or 11¼ cents. Mr. Krueger states also that in a type of lamp which he proposes to bring out shortly this price can even be reduced one-half.

SOCIETY AND CLUB NOTES.

THE USE OF ELECTRIC LIGHT IN LANTERN PROJECTION.[1]

BY E. P. HOPKINS.

The lecturer opened his address by touching briefly on the principles of lantern projection. He began with simple apparatus, without lenses, and using only a pinhole through which to project a picture. He then brought more complex apparatus into service, illustrating practically the gain in results, with single



ELECTRIC STEREOPTICON FOR DISSOLVING VIEWS.

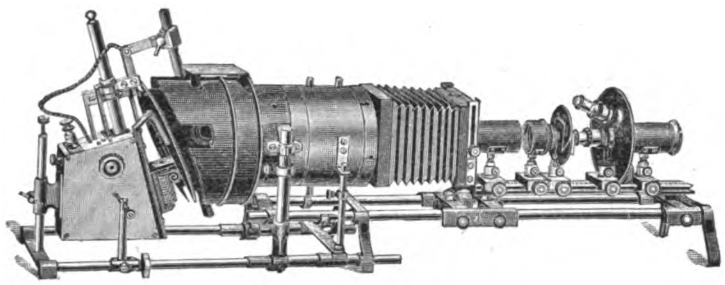
lenses, combination lenses, and lastly "condensers." In the last case, he showed the improvement obtained with two lenses in a condenser over the effect secured with but one lens.

The next step in the lecture was the exhibition of the value of different forms of illuminant for lantern work, such as oil light, Welsbach gas burner, calcium light and electric light. The gain

1. Abstract of an illustrated lecture before the New York Electrical Society, Jan. 23, 1895 at Columbia College.

in the last was most remarkable. The calcium light was shown at its usual brilliancy and also when forced to its utmost, at which stage a sharp hissing is heard. In each case, the source of light was made to exhibit on the screen its own construction. With the electric light a variety of subjects were shown in order to illustrate its effectiveness and superiority.

Mr. Hopkins next showed the adaptation of the electric lantern to dissolving effects, by the clever combination of two

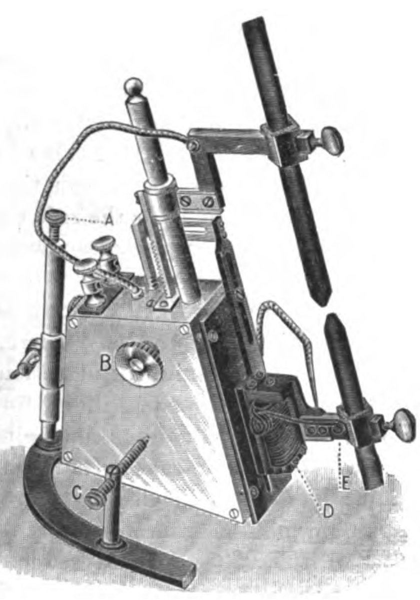


ELECTRICAL MICROSCOPE FOR LANTERN WORK.

lanterns, and the availability was proved by means of different kinds of slides and mechanical moving effects, such as the use of search lights at the World's Fair; the traveling beam illuminating brightly every object over which it passed. Another brilliant piece shown was that of the moon in the second quarter, taken from a negative that was secured at the Lick Observatory.

The electrical microscope was the next theme, and a most interesting one, Mr. Hopkins having it with him not only to use but to show and describe in detail. A single facet of a fly's eye was shown of the size of 12 inches square, and a small section of the eye was magnified until it reached from the ceiling to the floor, a distance of 14 feet, covering the screen as with a surface of beautiful tessalated pavement. This represented a magnification of from 2,000 to 3,000 diameters, with superb lighting.

The lecturer concluded with a brief description of the arc lamp used, running from the regular incandescent circuit, and scored a great hit by projecting on one and the same screen the crater of the arc and the dial face of the Weston ammeter giving the ampere reading. It was a source of great pleasure to see the variation of light and crater lighting surface according to the flow of current. The lamp regulated finely, burning with equal steadiness on 5 amp. and 25. President Mailloux called attention to the exemplification before their eyes of the law that limited the area of live crater to the amount of current passing. The delicacy



ARC LAMP FOR LANTERN PROJECTION.

and accuracy of the meter were also shown, the needle being quick in its response to every graduation.

At the close of the lecture Dr. Laudy, of Columbia College, long known as an expert in lantern projection, complimented the lecturer on the pains he had taken and on his success. It may be mentioned that through the courtesy of J. B. Colt & Co. the apparatus used was of the latest and finest type, its value reaching probably $1,500, and no expense had been spared in rendering its use easy and perfectly understandable by the large audience. During the evening Secretary Sinclair offered the names of over a dozen new members, all of whom were elected.

ADDING TO THE CLEVELAND PROGRAMME.

In addition to the list already published of papers to be read at the Cleveland meeting of this association, February 19, 20 and 21, there will be one by Nelson W. Perry, entitled "The Storage of Energy Essential to Central Stations: How It May be Accomplished and the Economies Resulting." Professor Langley, of Case School, and Professor Stine, of Armour Institute, Chicago, will take part in the discussion. The topic, "How to Light Large Cities," will be discussed by Frederic Nicholls, Charles R. Huntley, Frank H. Clark, J. Frank Morrison, T. Carpenter Smith, George A. Redman, E. F. Peck, and others.

LITERATURE.

Construction des Lignes Électriques Aériennes. By A. Boussac. Gauthiers-Villars et Fils. Paris, 1894. 6½ x 10. 318 pp. Price, $2.25.

THE volume before us constitutes the text book employed in the École Professionnelle Supérieure des Postes et Télégraphes, and forms a part of the complete course of M. E. Massin. We have of late had occasion to review a number of works treating of this subject, emanating from France, but none in which we find the work taken up in just this way. As it is intended for students, it is divided into a series of lessons, each taking up a particular branch of the subject, such as the study of poles, etc., and the methods of their preservation. This part is particularly useful, the various processes of preservation being illustrated. Then follow in succession the nature of the strains encountered in overhead line work, and the forms of construction best adapted to bear them. The insulator is then taken up and its various forms studied, and this is followed by the line wire, the methods of galvanizing, stringing, the calculation of the sag, tying, jointing, etc., each receiving their due share of attention.

These 25 lessons are admirably adapted for those who are engaged in line construction work, the literature on which, in English, appears to be lamentably out of date. Even to those who are not able to read French fluently, the engravings will be of considerable assistance.

AWARD OF THE ELIHU THOMSON PRIZE.

OUR readers will remember that in 1893 Prof. Elihu Thomson was awarded the first prize of 5,000 francs for his meter, in the electric meter competition organized by the city of Paris. Prof. Thomson very generously declined to accept the money and offered it as a prize for the best essay on a subject connected with the action of electrical condensers. The competition was organized by Mr. E. Thurnauer, general European agent of the Thomson-Houston Company, and a committee of judges was appointed consisting of Messrs. Carpentier, Fontaine, Hospitalier, Mascart Potier and Abdank-Abakanowicz.

Four essays were submitted and the prize was awarded to Dr. A. Webster, of Clark University, Worcester, Mass., who submitted an essay entitled: "An Experimental Determination of the Period of Electric Oscillation."

The essay which, in the judgment of the Committee, deserves second place was submitted by Dr. Oliver J. Lodge, in collaboration with Mr. R. T. Glazebrooke, of Trinity College, Cambridge. Their essay was entitled: "An Examination on the Absolute Accuracy of the Formula for Calculating the Period of Free Oscillation of a Discharge Condenser under Circumstances such that the Resistance of the Circuit has no Appreciable Disturbing Effect."

In response to the wishes expressed by the Committee of Judges, and at the instance of Mr. Thurnauer, a prize of 5,000 francs was also awarded to Prof. Lodge and Mr. Glazebrook, which was contributed by Prof. Thomson, the French Thomson-Houston Co., the French Thomson Meter Company, and the British Thomson-Houston Co., Ltd.

TELEGRAPHIC EQUIPMENT FOR THE SIGNAL OFFICE.

The War Department, through A. W. Greely, Chief Signal Officer, is inviting proposals until Feb. 4, 1895, for furnishing the Signal Office with telegraph and signal instruments, comprising in part electric bells, telegraph sounders, switches, relays, reels, telegraph keys, etc. Additional information, together with the necessary specifications, contract blanks, etc. may be had by addressing A. W. Greely, Chief Signal Officer, War Department, Washington, D. C.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIX. NEW YORK, JANUARY 30, 1895. No. 352.

CONTENTS.

MORE TROLLEY FOR STANDARD STEAM ROADS.

FOLLOWING closely on the announcement in our issue of Jan. 16, of the determination of the New York, New Haven & Hartford R. R., to equip its Bristol and Nantasket Branches with the trolley, comes the news, which an official confirms to us, that the Pennsylvania Railroad is to equip its Burlington & Mount Holly, N. J., branch with electricity. The effect of these steps on the future of steam and electric railroading is of the utmost importance. It is, indeed, being gradually brought home to steam railway managers that to fight the trolley on the old familiar lines of competing railways is futile, and that if they would hold their traffic, they must improve their steam methods practically out of existence and adopt those means which the trolley alone can offer. As indicating the condition of railways in a section of the country in which traffic may be considered to be fairly well established and stable in its nature, we may cite the report of the Railroad Commissioners of Massachusetts, which shows that no addition was made last year to the length of railroad lines in the State, except to second and side tracks. Making due allowance for the condition of trade, which would to some extent explain the practical standstill in steam railway construction during the past year, the considerable increase in electric railway mileage stands out in bold contrast to the steam railroad showing, and is a fair indication of the present tendency in railroad construction.

The contemplated action of the two main steam roads mentioned above again brings forward the question of long distance electric railroading, and the lines on which this work will be carried out in the near future. One of the important considerations which will be forced upon electrical engineers called upon to equip such lines will be the potential to be adopted. It is hardly to be supposed that in lines of 50 to 100 miles in length, which are even now in contemplation, advantage will not be taken of every point looking towards economy, and hence the potential to be adopted will receive active consideration. There is no good reason why the standard 500-volt city railway standard should be maintained on roads of such lengths, but the question is, to what point can the potential be raised with due consideration for the safe and continuous operation of the apparatus employed. Assuming that the use of continuous current apparatus will be continued, we have precedents of arc machines working successfully in some cases approaching 10,000 volts. These, however, are well housed and well cared for in central stations, and no manufacturer would assume the responsibility for the integrity of apparatus of such high voltage as applied to railway motors; but we are by no means certain that a voltage of twice that now employed in electric railroading, or say, 1,000 volts, would not be guaranteed by manufacturers. The adoption of this voltage would reduce not only the cost of copper, but the number of power stations along the line. In this connection it may be well to recall the estimates made by Mr. Frank J. Sprague in his inaugural address before the American Institute of Electrical Engineers at Chicago in 1892, in which he showed that if the three-wire system were used with the rails as a compensating conductor, with only two stations 42 miles apart between New York and Philadelphia, the potential required

would be only 900 volts ; and this can certainly be handled at the present time. This means, in effect, that the average railroad division can be handled by two or three stations distributed at equal intervals along the line, with a potential that offers no serious obstacles to the insulation either of apparatus or line, and which is not so high as to involve a serious drawback from the standpoint of personal safety. Questions of this nature are now forcing themselves to the front, and while we may expect that the standard street railway practice will be followed in the first attempts of steam roads re-equipping their lines with the trolley, the indications point strongly to the adoption of a higher voltage for the new work just begun. Considerations of higher voltage may also hasten the adoption of the alternating motor to railway work, thus eliminating the commutator trouble entirely from the problem.

CACOPHONY OF PIONEERS.

We have no wish to add to the prevailing dissonance in claims of antiquity on the part of some of our valued electrical contemporaries; but fear we shall have to put in a discordant word or two, however reluctantly. *Magna est veritas*, even in small matters. The uproar is all about the persistent claim of *The Electrical World* to be "the pioneer electrical journal," which its gifted proprietor has set forth prominently at the head of its editorial columns and in many circulars for some years.

About six years ago, it was our painful duty to admonish some of our contemporaries that their open rivalry in brag and horn-blowing was bringing electrical journalism into disrepute; and, referring particularly to *The Electrical World's* noisy proclamation of its pioneership, we said that such a claim sounded queer to people familiar with the facts and who "occasionally look over old files and may have come across some remarks of the principal proprietor, and recent editor-in-chief of the journal we have in mind—who once conducted a paper of a different class—in disparagement of electrical journalism and of the prospects of two periodicals which had already entered that field ahead of his present publication."

Below is an extract from *The Operator* of March 1, 1882, which we had in mind when the above was penned, May 1889.

"A new electrical journal, called *The New York Review of the Telegraph and Telephone and Electrical Review*, edited and published by Mr. George Worthington, formerly superintendent of the Gold and Stock Telegraph Company's telephone department, was issued Feb. 15. It is a bright-looking 16-page paper, not unlike THE OPERATOR in general appearance and size, though we are afraid that its price ($2 per annum, or 10 cents a copy) will militate against its widespread circulation. Its Salutatory announces that the new journal will confine itself to the discussion of electrical subjects, but since the *Electrician*, of this city, has already occupied that limited field, we shall look for an early departure of either one or the other into the realm of general telegraphic and telephonic current events. Indeed, the field which the *Review* and *Electrician* have both chosen is already covered pretty thoroughly in all its important matters, since one can hardly pick up a magazine or newspaper in which the latest electrical discovery is not exhaustively treated. The percentage of telegraphers who make deep researches into the technical mysteries of our craft is decidedly small, and it follows that the circulation of a journal which does no more than delve into an abyss of algebraical signs must be correspondingly limited."

Although electric lighting had been well developed and electric power was already attracting attention, it will be noted that the editor of the *Operator*, since and now publishing *The Electrical World*, in March 1882, said that a journal [The Electrician, afterwards The Electrician and Electrical Engineer, and, beginning with 1888, The Electrical Engineer] devoted to the "Advancement and Diffusion of Electrical Science" had chosen a "limited field" as compared with the "realm of general telegraphic and telephonic events." *The Operator* was in no sense a general electrical paper, and even in its own field of telegraphy was not a "pioneer" —*The Telegrapher*, established in 1864 by Mr. L. H. Smith, and subsequently conducted by the late J. N. Ashley, was in existence till February, 1877.

The Electrical World has sometimes claimed to be the "pioneer journal" and sometimes the "pioneer weekly journal." The *Electrical Review*, January 23, 1894, makes good its right to the claim of priority in weekly issues, but as among existing journals The Electrical Engineer is pioneer, although published monthly till 1890. The first issue of *The Operator & Electrical World* appeared in January, 1883. The first number of *The Electrical World* as such did not appear till April 28, 1883, over fifteen months after the first issue of The Electrician.

Readers are more interested in the quality than in the antiquity of a periodical, and we feel that some apology is due them for taking up space and time with this topic, and are not likely to trouble them further with it. If, however, any value age, among other qualities, they should know that on the first of January, 1882—when our first number (The Electrician) appeared—there was no other general electrical periodical extant in the United States.

MUNICIPAL LIGHTING WORK IN ENGLAND AND AMERICA.

It chances that we illustrate this week two municipal lighting plants, one in England and one in America. Both articles will, we think, be found of interest, whether in illustrating differences of practice or in showing that the municipal plant is a distinct and continuing element in the development of the art. While such plants are still the exception in this country, they are becoming the rule in England. It is possible that if all the municipal work were as well done in America as we know it to be at South Norwalk, there might be larger expenditure of public moneys in that direction ; but we make bold to say that the intelligent and expert supervision given by Mr. Winchester, aided by public spirited colleagues, is rare.

It is a remarkable fact that in England the progress of electric lighting has had to await municipal expenditures. In all England there are to-day less than 2,000,000 incandescent lamps connected to central stations, and of these at least 30 to 40 per cent. are furnished by municipalities. In the counties or "provinces," the incandescent lighting done by private companies is actually smaller than that done by the municipal authorities; while we believe that the provincial arc lighting is almost wholly in the hands of the local bodies.

In England the alternating and continuous current systems run each other pretty closely, there being a difference of but a few thousand between them. The alternating plants are probably all later and newer ; but still it is of interest to see, as we pointed out last week in reference to the description of the Chicago Edison station, that the continuous current remains on excellent terms of parity with its younger rival. In both countries, it is apparently holding its own where lighting is chiefly considered, although in Chicago 40 per cent. of the current is consumed in motor work.

So far, however, neither in England nor in America is there a municipal station that compares with the large stations run by companies in such cities as New York, Chicago and Boston. When there is, it will be an extremely inviting and useful task to compare the respective economies. In America at least, most of the municipal plants have been established in places where it did not pay a private company to put money into the business.

ELECTRIC TRANSPORTATION DEPARTMENT.

SIEMENS ELECTRIC RAILWAY WORK AT HOBART, TASMANIA.

An interesting article on the electric tramways of Hobart, Tasmania, recently appeared in *The Railway World*, of London, from which the accompanying illustrations are reproduced. The Hobart Tramway Company, Limited, an English corporation, was organized in 1892, and immediately set to work to fully equip the railways of Hobart with electricity, giving the contracts for the plant, power house and cars to Messrs. Siemens Bros. & Company, Limited.

There are three routes now in operation, all more or less hilly and circuitous, though the sharpest curve has a 70 foot radius and the steepest gradient a rise of 1 in 17. The three lines all have a single track with seven passing places so disposed as to allow a 15 minute service with four cars on each route.

The track is laid on hard wood sleepers, three feet apart, and consists of 40 pound rail of Vignoles section, with two continuous guard rails of the same section, but with the inside flange cut off, so as to lie close to the running rail, forming a groove 1¼ in. wide for the wheel flange. The surface between the rails and for a little distance outside is laid with asphalt. The rails are joined by means of ordinary fish-plates and bolts; but one running rail in addition is bonded at each joint by riveting to each end a corrugated copper strap 10 inches long by one inch wide. The gauge is 3 feet 6 inches.

Side pole construction is used throughout. Siemens iron poles

Siemens Electric Cars, Hobart, Tasmania.

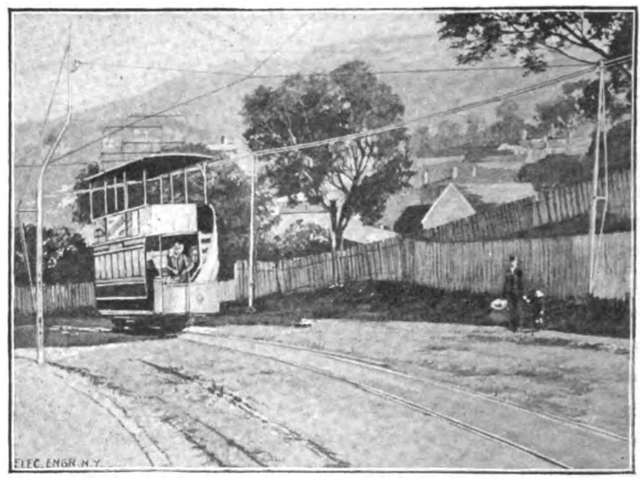
are placed 40 yards apart, straight on one side of the street, but bent on the other side to avoid the telephone wires.

Each pole carries a white porcelain insulator, and the steel span wires are stretched from one to the other at a height of 18½ ft. from the ground. No insulator is used between the span wires and the trolley wire which is also of steel 6.5 mm. in diameter.

The feeders are of stranded copper with diameter proportioned to the distance from the power house so that there is a tapering down along the line, the wires being all of 2.3 mm. diameter, but a less number of wires being used in the further strands. By this means the resistance of each line of feeders is nearly equal, and an even fall of potential over the whole of the three lines is attained.

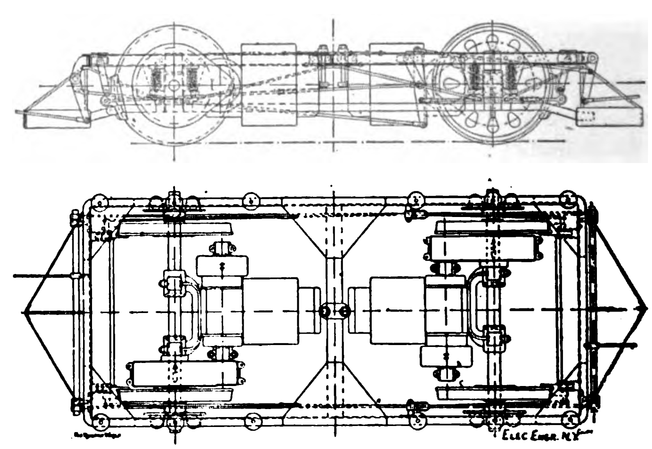
The rolling stock, at present, consists of twenty double deck cars. These are arranged to seat 24 passengers inside, and the same number outside, while there is standing room on the end platforms which is not unfrequently occupied. The cars, complete, weigh less than six tons apiece, and each is fitted with two Siemens H. B. 812 motors, each capable of developing 12.5 horse-power, and running at a normal speed of 400 revolutions per minute, with single reduction spur-gears running in oil. The two motors are connected in series, and can be controlled from either end of the car. At one end of the car is also the switch and resistance for controlling the electric lamps with which the car is lighted, two being fixed to the roof inside, and one as a signal lamp at either end. Current is taken from the trolley wire by means of two arched collectors, one at either end of the car.

The power-house is close to the joint terminus of the three lines. It is a corrugated iron building, 100 feet long by 50 feet wide, divided into coal bunkers, boiler room, engine room, and work-



Scene on Hobart Electric Railway, Tasmania.

shop. The boiler room contains four Marshall multitubular locomotive type boilers, each of 60 nominal horse-power with a pressure of 160 lbs. to the square inch. The smoke is carried by underground flues to the base of the chimney, which is a wrought iron cylinder 90 feet high by 5 feet in diameter, standing on a foundation of 13 feet of solid masonry, on piles driven 15 feet down to the rock. The boilers are fed by two Worthington pumps, taking their supply from a tank capable of holding 4,000 gallons placed above the coal bunkers. The feed water is heated



Electric Car Truck, Hobart, Tasmania.

by passing through two water heaters with vertical brass tubes, where its temperature is raised to 150 degrees Fahrenheit before it enters the boilers.

In the engine room are three Willans I. I. engines each coupled directly to a Siemens H .B. 21/36 dynamo, mounted on its bed plate. Each unit gives an output of 250 amperes at a pressure of 500 volts when running at a speed of 350 revolutions per minute. The foundation for each unit consists of a solid block of concrete of 15 cubic yards, resting on the piles. The steam is supplied to the engine through a ring-

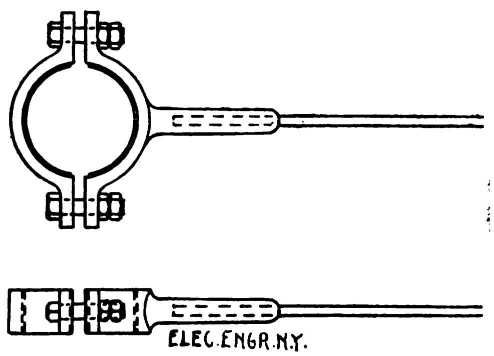
main, so that any one can be isolated. The exhaust passes through a 12in. main to the feed-water heaters. Ordinarily, only two dynamos are used, the third being held in reserve; and it is found that two of the boilers can supply the necessary steam. The switch-board is fitted with three double-pole main switches, interlocked with the shunt-circuit switches, with ammeters and volt meters, and the necessary regulating switches for varying the strength of the field.

A conclusive proof of the efficient equipment of the line may be found in the fact that on the occasion of a horticultural show at Newtown, 12 cars were running all day on this line in place of the usual four, and each car carried on the average 75 passengers, or 27 more than its normal load, without any difficulty being found in surmounting the grades. Mr. A. C. Parker, manager of the company states that their lines have carried in 365 days 1,432,899 passengers, ten times the total population of Tasmania, or an average of 4,000 *per diem* including Sundays, and that they have run 351,741 car miles.

WATER PIPE CLAMP FOR ELECTRIC RAILWAY RETURN.

The report of the Brooklyn Subway Commission on Electrolytic Action due to electric railway currents, noticed in a recent issue, contains a description of a clamp specially designed for connecting return leads to water pipes.

The form of clamp shown was made under the direction of Mr. M. G. Starrett, chief electrician of the Brooklyn Heights road, and was used in making attachments to water mains in certain portions of Brooklyn for experimental purposes. The collar is of wrought iron in two parts, five-eighths of an inch thick and two inches broad; the two parts are drawn together by three-quarter bolts, with two nuts to each bolt, the collar being previously turned out upon its inner face to one-quarter of an inch



WATER PIPE CLAMP FOR ELECTRIC RAILWAY RETURN.

larger than the diameter of the pipe to which it is to be applied. Midway in one part, is formed a lug into which is brazed a No. 00 copper wire.

In applying the connection the pipe is carefully brightened all around with a file; a strip of bright lead five thirty-seconds of an inch thick and two and one-half inches broad is laid around the pipe, and the collar is clamped down by the bolts until the lead gasket is mashed into the inequalities of the pipe. The lines of junction between the collar and lead pipe are thickly painted over with "P. & B." mixture, then completely taped over, and again painted with "P. & B." upon the tape, after which the whole is thoroughly packed in with good cement.

TO LIMIT STREET CAR SPEED IN BROOKLYN.

Mr. Wieman, a Republican assemblyman from Kings County, has introduced in the New York Legislature a bill forbidding any street railroad in cities of over 250,000 inhabitants to run cars faster than 6 miles per hour. This legislation is aimed more particularly at the Brooklyn roads, but would affect New York and Buffalo.

ELECTRIC RAILWAY WORK IN CHICAGO.

Application of electricity to intramural transit has caused the expenditure of nearly $1,000,000 for the construction of power-houses. Among the latter, either completed or nearly so, are: Power-house for the West Chicago Street Railway Company, at 47 Western avenue, $120,000; car house for the same company, West Madison street, to cost $70,000; power plant for the Chicago Electric Transit Company at Roscoe boulevard and Chicago avenue, to cost $200,000; car barn for the same company at Elston and Warner avenues, to cost $40,000; power house for the Metropolitan "L" Road, Loomis street, to cost $200,000; repair shop for the same company, Throop street, to cost $80,000; power house for the Chicago General Railway Company at Thirty-first street and Kenzie avenue, to cost $40,000; car house for the same company at the same place, to cost $20,000. The Metropolitan "L" Road Company has expended about $150,000 on stations.

A SWISS MOUNTAIN ELECTRIC RAILWAY.

The Swiss Federal Government has recently granted a concession for the construction of a mountain electric railway, starting from near Lauterbrunnen, and running via Little Scheidegg. The line will be about 12½ kilometres long, and is to be finished within five years. The water power of the Trümmel is to be utilized in generating the necessary electric energy.

A TROLLEY "TRUCK FARM" ROAD. FOR ELYRIA, O.

The farmers and truck raisers of Erie and Lorain counties have organized to construct an electric railway line between Elyria and Milan, Erie county. The distance is about 30 miles. The following towns will be tapped by the road: South Amherst, Henrietta, Birmingham, Florence, and Berlinville.

COST OF OPERATING THE CHICAGO CITY TROLLEYS.

The report of the Chicago City Railway Company shows that the cost per car per mile of operating the electric lines was nearly 17 cents, or 4½ cents more than the cables, and considerably more than the West and North Side Companies have been counting on for their lines when built. Net earnings of the City Railway for the year were 13.53 per cent. on the stock, against 19.01 in 1893. It would be interesting to have some explanation of these unusually high figures for trolley work, which are not sustained elsewhere.

VESTIBULES FOR STREET CARS.

W. D. Mahon, President of the Amalgamated Association of Street Railway Employees of America and Canada, has been in Milwaukee in the interest of legislation during the present session at Madison. A bill is being drafted which will be presented to the Wisconsin lawmakers, making it obligatory upon every street-car company in the State to transform all street cars into vestibules, front and rear, for the purpose of protecting the motorman from the icy blasts of Winter. The plan has already been adopted on the Farwell avenue line in Milwaukee. The national organization, Mr. Mahon says, has decided to advocate the matter before the Legislatures of four States this year—Wisconsin, Michigan, Indiana and Colorado. The work in Michigan is being attended to by M. G. Moore, secretary of the association, who is a member of the body from Detroit. The outlook for a passage of the law is good, it is said, both in Indiana and Colorado.

NEW TROLLEY CARS FOR HARTFORD, CONN.

An executive meeting of the Hartford Street Railway Company has awarded contracts for fifty-six more cars for the trolley lines, of the open or summer style. These will be of the latest pattern and highest grade of workmanship, and provided with the latest approved safety device to prevent passengers getting out on the side where there is another track. They are also to have the folding steps. Of the new cars now ordered, twenty-three are to be vestibule cars for suburban service, and thirty-three of the bulkhead style. All will be of the latest and most approved designs, and each car will be designed to seat from forty-five to forty-eight passengers. J. G. Brill & Co., Philadelphia, get the contract for 25; the Jackson & Sharp Company, Wilmington, get 25; and 6 will be made by the American Car Company of St. Louis. All are to be delivered by the 1st of April. The company is now running some 170 cars, of varying styles and kinds, but of these the old styles are to be discarded, and only the new ones, now in use, retained. Altogether, it will give the service seventy-six open cars, to begin with, without counting the others.

THE NATIONAL RAPID TRANSIT RAILWAY COMPANY.

Senator Teller has introduced, by request a bill in the United States Senate to incorporate the National Rapid Transit Railway Company, which proposes to construct an elevated electric road between Washington and New York. The bill, which has been read twice and is now in the hands of the Interstate Commerce Committee, authorizes the company to organize with $15,000,000 worth of stock which may be increased to $25,000,000 if desired. The company is to lay out, build and equip the road from Washington to a point on the Hudson River opposite New York, with one more tracks and will use the Brett elevated electric system. When it passes a city or village it shall be sufficiently elevated to permit the passage of teams and traffic beneath it, or else shall

run under the ground so as not to interfere with traffic. The road is to carry passengers and mails, and may also carry freight if the projectors and managers desire. It is proposed to run trains at a speed of 120 miles an hour.

Among those whose names are connected with the enterprise are Noah L. Jeffries, Joseph J. Reynolds, John J. Hemphill, Charles M. Shelley, Samuel M. Bryan, A. M. Bliss, Howard S. Reeside, Lewis A. Grant, Benjamin Butterworth, John F. Vinal, George F. Brett, Hamilton Disston, C. F. Kindred, Isaac D. Hetzell, Virgil D. Stockbridge, Hiram Woods, H. C. Turnbull, William L. Brown, Thomas Ewing, John C. Calhoun, Henry Cummings, Moses Sweetser and Henry T. Wells.

TELEPHONY.

THE MUTUAL AUTOMATIC TELEPHONE CO. IN PHILADELPHIA.

James Breen, Secretary of the Exhibition Committee in Philadelphia during the World's Fair, has made an affidavit charging that $362,000 worth of stock of the Mutual Automatic Telephone Company was distributed to purchase the passage of a blanket franchise through the city councils. The Mutual Automatic Telephone Company is a New Jersey corporation, presided over by W. H. Eckert, the well known telephone manager, of New York, with an authorized capital of $1,000,000, but only the amount necessary to secure the charter is paid in. The officers are closely connected with powerful political elements and corporations.

It is stated that $500,000 worth of stock of the company, out of $650,000 remaining unsold, was put in the name of Julian C. Gale, a young man employed in the office of F. P. Persch, the Treasurer. It is reported that two prominent politicans got $75,000 each in stock to push the ordinance through. They deny the charge flatly.

T. H. Stackhouse, Secretary of the company, said he did not know personally of a single politician who held stock in the company. He thought that the accusation was due to some difficulty which Mr. Breen had had with the company.

The company owns the automatic switchboard devices of an inventor named Allison.

The Drawbaugh and Central Telephone franchises were sidetracked in council in favor of the Mutual Automatic.

THE "AUTO-TELEPHONE" SYSTEM.

THE great advantage of rapid communication between heads of departments and subordinates in large offices, factories, hotels, clubs, etc., is too apparent to require any special pointing out, and it is not necessary to dilate upon the great value of a feasible intercommunicating telephone system designed to accomplish this. One of the most recent attempts to supply this want is embodied in the Auto-Telephone System of the Tucker Electric Construction Co., of Nos. 14 to 20 Whitehall St., New York.

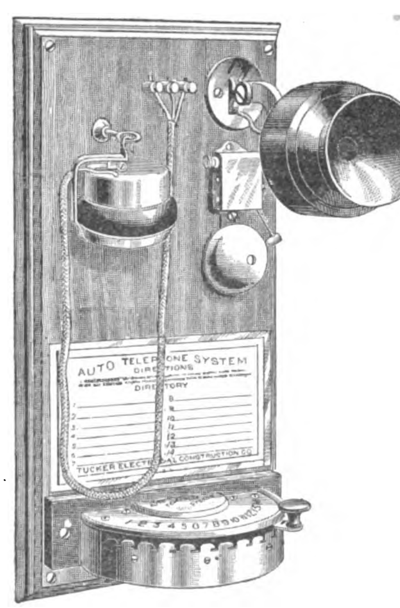


FIG. 1.—THE "AUTO-TELEPHONE" WALL SET.

The system is designed to allow of the greatest flexibility of operation. By its means the manager can call up any one member of his staff, or two or three, and maintain communication with all three or more at the same time. The system is so arranged that, when desired, certain stations only can call a given station, although that one station is in such relation to the system that it can call all the others. This allows the manager, for instance, to call up any one on the system, but relieves him of the burden of answering calls from subordinates.

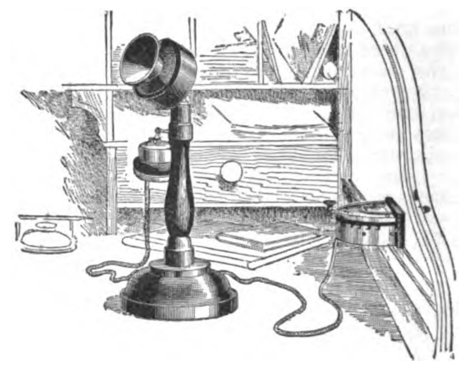


FIG. 2.—"THE AUTO-TELEPHONE" DESK SET.

Our engraving, Fig. 1 shows the wall set and Fig. 2 the desk set for three or more stations. The single switch by which the desired connections to other telephones are made is so arranged that the switch lever is maintained in contact during the conversation, thus leaving one hand free for taking notes.

When the switch is set for a given station the act of taking the receiver from the hook rings a bell, which keeps on ringing until the person called takes his receiver from the hook. This gives a ready means of ascertaining whether the call has actually been received at the other end of the line, and avoids delay in case the person called is absent. Besides it is a constant indication of the working condition of the circuit.

The apparatus of the Auto-Telephone System is beautifully finished in ebonized wood and nickel and is sold outright. Besides the sets for three or more stations, a single set is made for communication between residence and stable or other outlying buildings.

NEW TELEPHONE EXCHANGE IN BOSTON.

The New England Bell Telephone Co. has opened a new central in Boston known as the "Haymarket," with 1,200 subscribers. It is a model telephone building. Like that on Milk street, it is strictly fire-proof; it is four stories high, and has a high and airy basement. It is heated by hot water, and has the most modern ventilating system. The operators are given a pleasant parlor, dining-room, bathrooms, etc. To further add to their comfort, a matron is present whose sole duties are to look after their wants when not on duty at the switchboards.

The multiple switchboard embraces the latest and most approved apparatus known to the art. The trunking system between this office and Milk and Tremont streets is equipped with the latest apparatus, including "lamp signals," for showing the operators at one office when the lines at the other office are disconnected. It is amusing to see these many little electric lamps light and extinguish in rapid, fantastic order. Such signals are found more certain than movable shutters, heretofore employed for this purpose. These signals will also be placed on the Milk street end of the trunk lines.

The switchboard at present is equipped for some 45 operators, 15 of whom attend to inward-coming trunk lines from other offices.

To aid both operators and supervisors in responding promptly to all calls of subscribers, many little instruments called "tickers" are arranged on the switchboard, which act in conjunction with the line annunciators, by which a sound or "tick" is given at every second from the time an annunciator indicates a call, until the last call is answered and the annunciator has been automatically restored. By this means, both eye and ear are continuously attracted to the calls of subscribers, making the first call certain of being answered.

Some interesting statistics of the new switchboard are:

Subscribers' annunciators	1,380
Trunk lines	280
Spring jacks	25,800
Connecting cords	746
Soldered connections	250,000

The cost of the switchboard in this office is about $50,000.

PENN YAN, N. Y.—A local telephone exchange is being talked of in this village.

AUCTION SALE OF BELL TELEPHONE STOCK.

The directors of the American Bell Telephone Co. have voted to sell the remainder of the new issue of stock at auction, 3,300 shares being unsubscribed for by the stockholders. The date of the sale has not been fixed. The price of the stock declined on the Boston Exchange to 191 on receipt of the news.

TELEPHONE NOTES.

CORSICANA, TEX.—The Corsicana Mutual Telephone Co. has been granted a franchise by the city.

LANCASTER, N. H.—Mr. Bushey, superintendent of the new telephone line, expects to have it working February 1.

CLINTON, N. Y.—There is talk of establishing a private telephone line from the village to College Hill.

PURVIS, MISS.—A telephone line is soon to be established between here and Columbia, a distance of thirty-two miles.

MONTROSE, PA.—A new telephone company has been formed at Montrose.

NEWARK, O.—The Newark Telephone Company expects to have its system in operation by April.

LAFAYETTE, IND.—The Bell Company has met competition with a reduction in its rates.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph company have decided to put their wires underground in Syracuse and the work will be begun early in the spring.

JOHNSTOWN, PA.—The American Electric Telephone Company has been formed at Johnstown with a capital stock of $15,000. The rental charged will be $30 a year.

CLAYTON, MO.—The St. Louis County Telephone Company of Clayton has been formed; capital stock, $5,000. Incorporated by M. B. Greensfelder, E. W. Warfield, O. H. Benoist and others.

POTTSVILLE, PA.—Preparations have been made for a new long-distance telephone line from Pottsville to Minersville, Heckscherville, Greenberry and Llewellyn.

TIPTON, IND.—The Tipton Telephone Company has been formed; capital stock, $10,000. Directors, E. H. Shirk, W. W. Mannis, G. M. Shartle, N. S. Marks, Jacob Kern, Jr.

LUMBERTON, MISS.—A company has been organized to build a telephone line from this place to McComb City, via Columbia, Tylertown and Magnolia.

CONWAY, ARK.—The Southwestern Telephone Company is obtaining subscribers, preparatory to putting in a system for Conway.

ELIZABETH, N. J.—The city council of Elizabeth has granted a franchise to the Elizabeth Mutual Telephone Co. to erect poles, establish an exchange, etc., in the city.

MIDDLEBURGH, N. Y.—The new telephone line between this village and Oak Hill will soon be constructed by a stock company. There is also some talk of extending the line from Blenheim, thus making connections with Gilboa and Conesville.

CINCINNATI, O.—The Anthony Electric Company have petitioned for a franchise for the purpose of conducting a telephone, burglar alarm, district messenger and telegraph service in this city. The board referred the matter to the City Electrician.

DANVILLE, ILL.—The Danville Telephone company has been formed; capital stock, $25,000; to operate a telephone exchange; incorporators, Elliott E. Benedict, William W. Tobey and John White.

ASBURY PARK, N. J.—A local telephone company is being organized at Asbury Park. A number of subscribers to the New York and New Jersey Telephone Company have, it is said, ordered their 'phones taken out because of refusal to reduce rates.

GORHAM, ME.—A meeting of the incorporators of the Gorham Telephone Company has taken place to perfect an organization. These officers were elected: Pres.—Isaac W. Dyer, Treas.—Fred W. Harding, Sec.—Isaac W. Dyer, Sup.—C. Hayes, Directors—Stephen Hinkley, Isaac W. Dyer, Fred W. Harding.

GRAND RAPIDS, MICH.—The Telegraph and Telephone Construction Company have again asked consideration of an ordinance giving it the privilege of constructing conduits in the streets for the purpose of running its wires underground; the matter was referred to the committee on ordinances.

BINGHAMTON, N. Y.—The Binghamton telephone exchange, which has heretofore charged $60 a year for each instrument irrespective of the number of calls made over it, has adopted a new system and hereafter subscribers will be charged in accordance with the service required.

PORTLAND, N. D.—An effort is being made to build a telephone line from Portland to Fargo, over either of the following routes: Galesburg, Erie, Ayr, Absaraka, Wheatland and Casselton; or through Galesburg and Hunter.

The last report of the Mexican Telephone Co., to October, 1894, showed a falling off of 99 subscribers since March. The earnings, however, were a little larger, being $69,914 against expenses $41,142.

SIOUX CITY, IA.—H. O. Woodruff, of the Sioux City Electrical Supply company has asked, that an ordinance granting a pole franchise to the Sioux City Telephone company, which passed its first reading last summer, be placed on its second and third readings and passed.

FAR ROCKAWAY, N. Y.—The wires of the Automatic Telephone and Electric company in Far Rockaway have been removed from the poles by the Citizen's Lighting company. A right has been granted to the telephone company by the village trustees to erect their own poles.

SYRACUSE, N. Y.—The Central New York Telephone and Telegraph Company is going to erect a building in Syracuse for its exclusive use and put the telephone wires of the city underground. The work will be completed in a year. Mayor Amos says the electric lighting wires must go underground too.

INDIANAPOLIS, IND.—The Central Union Telephone Co. are preparing to put their wires underground, and are in consultation with the city authorities and other local electrical interests on the subject. The underground work will chiefly be restricted to the central sections of the city, and large use will be made of cables.

NEWBURGH, N. Y.—The telephone company has completed its metallic circuit line to Newburgh, and a test was made of it this afternoon. It worked perfectly and conversation with New York, Albany, Saratoga and Glens Falls was carried on with perfect ease.

FARMINGTON, MO.—Arrangements are being made for the building of a telephone line from Taylor Place, in the Flat River district, to Farmington, and it will also be extended in the opposite direction, so as to take in Desloge, De Lassus and Bonne Terre. The projectors of the new enterprise are John Dryden and John A. Sprott.

THE TRI-CITY TELEPHONE COMPANY of Clinton, Ia., has been incorporated with a capital stock of $40,000 and secured a twenty-year franchise from the councils of Clinton, Lyons and Fulton. The Harrison system will probably be used. The officers are: P. S. Towle, president, C. C. Coan, vice-president, Artemus Lamb, treasurer, H. D. Patterson, secretary.

MANCHESTER, N. H.—The New England Telegraph and Telephone company has announced to patrons that a reduction in rates heretofore charged will be made February 1, and that all subscribers who have paid in advance for the quarter ending March 31 will be given a rebate and put on the list as new subscribers of the date on which the new schedules go into effect.

SAULT STE. MARIE, MICH.—Capitalists at Sault Ste. Marie ask a franchise to operate a telephone line there. The Edison Sault electric company is in the deal, and has proposed to string the wires on its electric light wire poles. The proposed company agrees to sell an instrument to subscribers for $35 and then furnish service at the rate of $15 a year for residences and $18 a year for business places.

PETERSBURG, VA.—A communication has been received from a telephone company in New York city, offering to establish a telephone exchange in this city, at a cost of from $2 to $5 a month to each subscriber. It is proposed by the New York corporation to organize a joint stock company of Petersburg people, the telephone company taking a part of the stock, with a capital of $10,000, the chamber of commerce to secure the franchise from the common council.

SPRINGFIELD, MASS.—The local telephone management, in accordance with general orders from headquarters at Boston, has announced that on and after February 1, the telephone rates will be reduced, the same to take effect in the bills which have been sent out the present quarter. The rates will be as follows: Long distance office, $102, formerly $105, a year; metallic lines, offices, $60, formerly $75; residences, $54, formerly $60; grounded lines $39, formerly $40.

ST. LOUIS, MO.—A bill has been introduced by Representative Buckner, to regulate the rental to be charged for the use of telephones in cities of over 100,000 inhabitants, and fixing a penalty for its violation. No company or corporation will be allowed to charge, collect or receive as rental for the use of telephones in such cities an amount exceeding $40 per year; in cities containing 30,000 and less than 100,000 inhabitants they shall not be allowed to charge more than $30. Not more than 25 cents for five minutes shall be charged for the use of telephones between two cities.

CANADIAN GENERAL ELECTRIC PERCUSSION AND ROTARY DRILLS.

The accompanying illustration shows in operation at the Windsor Gypsum Quarries, Windsor, Nova Scotia, portable electric percussion and rotary drills which have lately been introduced and are being manufactured by the Canadian General Electric Co.

The percussion drill in general external appearance conforms very closely to the regular type of steam and air drill; in fact the tripod and shelf are of the standard steam drill form. Electrically, it is arranged in the form of a solid piston reciprocating in a magnetic field and controlled thereby. The piston is provided with a standard air drill rotating rifle-bar and the usual form of springs to protect the front head of the drill from blows. The drill has a piston diameter of 3¾", a length of stroke from 6⅛" to 8½", length of feed 24", number of blows per minute, 360 to 380.

The first of these drills was installed on the Canadian "Soo" Canal last winter, when the contractors, Messrs. Hugh Ryan & Co., were greatly pleased with its performance. On these works the performance was equal to that of a 3" steam drill, and the facility with which the drill could be moved, owing to the complete flexibility of the connections, was especially remarked. As far as economy goes, it far surpassed any other drills on the works. The cost of operating, including power for operating the generator and labor of the attendant at the power house, was somewhat under the average operating expenses of the steam drills. In the Windsor Gypsum Quarries, Windsor, N. S., where one of these drills is in operation, every satisfaction is being given by it. The best day's work of one drill on record is ten 10 ft. holes in 9 hours and 20 minutes. This was in glow lime stone.

The rotary drill is designed especially for use in coal mining, but has also been used with great success in the Gypsum Quarries of the Windsor Gypsum Co., where the clayey nature of the material tends to clog the drill and imposes the severest test on the capability of the machine. The drill is similar to the well-known Howell's drill with an electric motor geared to it in such a way as to form a light and efficient tool. The control of the motor is effected by a small plug switch. No rheostat is used, and power may be taken from the same wire supplying current for lighting, pumping or haulage.

Feed screws of different pitch are furnished for varying the speed of boring and a friction clutch protects the motor should any particularly hard obstacles be struck suddenly.

The columns are made in different lengths and each is adjustable for about two feet variation. The construction of the drill and its method of mounting enable the operator to drill close to the roof, floors or walls as well as in any direction. The drill weighs with post complete only about 160 lbs., the drill itself weighing 100 lbs. In bituminous coal this drill shows a speed of drilling of 7 to 10 feet per minute.

CANADIAN GENERAL ELECTRIC PERCUSSION AND ROTARY DRILLS.

MUNICIPAL LIGHTING AT NEWARK, O.

The report made by Superintendent Y. E. Young, of the Newark electric light plant, shows the expense of operating the plant for the past six months was $640.38 less than that for lighting the city by gas. This takes into consideration $1,110.44 interest paid on $40,000 bonds for that period.

OBITUARY.

RUDOLPH EICKEMEYER.

It is with sincere regret that we record the death, at Washington, D. C., on Jan. 23, of Rudolph Eickemeyer, of Yonkers, N. Y., whose name has been for so many years prominently associated with electrical progress.

Rudolph Eickemeyer was born in Bavaria, October 18, 1831. He was educated at the Polytechnic Institute at Darmstadt and came to this country with his friend and future partner, George Osterheld, in 1850 after participation in the revolutionary movement. His first work in the United States was with the Erie Railroad. The following year he assisted in building the first mowing machines made in this state by the Buffalo Steam Engine Works. In 1854 he established himself at Yonkers with Mr. Osterheld in the business of repairing tools used in the hat shops there. It was while there that his inventive genius first displayed itself, and in a short time he began the course of invention that has resulted in practically re-creating the art of hat making throughout the world. During the Civil War he manufactured large quantities of novel revolvers, and in 1869 and 1870 he invented a driving mechanism for mowing machines for which the Centennial Exposition awarded him a bronze medal. Other medals were awarded the firm of Osterheld and Eickemeyer for improved hat machinery at the same time.

Altogether, before beginning his electrical work Mr. Eickemeyer took out no less than 150 patents for improvements in various classes of mechanical work. His interest in electricity began with telephone experiments which familiarized him with the forms of electromagnets. From this he took up the construction of dynamos and motors. The early form of "Eickemeyer" ironclad dynamo was the result of study and investigation extending over a period of ten years. The Eickemeyer motor proved verry efficient in railway work and its winding was adopted for the railway motor of the Edison system. The question of the best kinds of iron for dynamos led him to construct the magnetic bridge that has proved so useful in simplifying and shortening experimental work, which, without its aid, would have been difficult and expensive. His work in the storage battery and alternating current motor fields is interesting, and, in the latter case, surprising early.

Mr. Eickemeyer was married in 1856 to Miss Mary T. Tarbell, of Dover, Me., who together with six children, survives him. An excellent portrait, taken a little more than four years ago, appeared in THE ELECTRICAL ENGINEER of Dec. 17, 1890.

A. H. BAUER.

The news of the death of Mr. A. H. Bauer will be received with deep regret in more than one electrical circle, his activities having ranged over several departments of work. Mr. Bauer was born in Baltimore in 1846. He entered the service of the Baltimore & Ohio Telegraph Co. as a messenger in 1859, learned the telegraphic art, and was assigned to Annapolis in 1861, using the old Morse register. He remained in the railroad telegraph service until 1864, acting frequently as a government operator during the campaigns of the civil war in Western Virginia. He next

accepted a position with the U. S. Telegraph Co. at Philadelphia. He was arrested, and was confined later with several other operators in the old Capitol Prison at Washington, D. C., on the charge of being concerned in the transmission of a bogus proclamation by President Lincoln calling for 300,000 men. Upon his release he joined the Western Union Telegraph force at Baltimore, filling various positions up to that of manager for the Gold & Stock ticker service and the Edison Carbon Telephone Co. He afterwards accepted the position in Baltimore of manager for the Mutual Union Telegraph Co., upon the collapse of which he gave up the telegraph field in disgust and permanently. He became greatly interested in storage batteries and in 1882 entered the employ of the Electric Storage Co., of Baltimore, where he remained two years, doing a good deal of the pioneer work in that line in this country. He then joined the staff of the Electrical Accumulator Co. of New York, with whom he stayed for about a year. The Pullman Car Co. then engaged his services as chief electrician and he remained with the Pullman interests down to the time of his death, taking a very active part in the electrical equipment and management of their parlor and sleeping cars, particularly in the South and West.

Mr. Bauer was a hard worker, and though he had never had the benefit of systematic early training, was a well informed man on all the electrical developments of the day, reading closely and experimenting assiduously. He was a careful student and took a broad interest in his profession. He was a member of the American Institute of Electrical Engineers, to whose transactions he contributed valuable data. His death, which was due to Bright's disease of the kidneys, occurred in New York City on Jan. 15, and the body was taken to Baltimore for interment. His son, Mr. W. F. Bauer, is known to many readers of this journal as an electrical engineer.

REPORTS OF COMPANIES.

ANNUAL REPORT OF INTERIOR CONDUIT AND INSULATION CO.

The annual report of the Interior Conduit and Insulation Co. shows a steady growth of business throughout the dull times. The net sales for the past three years are given as follows:

Net sales, 1892	$356,061
" " 1893	478,652
" " 1894	534,712

The gross profit on the business of 1894 is $101,768. The business has been done very closely down to a cash basis, and the amount to be written off for bad debts was only $756.14. All branches of the business were active, that of conduit manufacturing reaching $328,531 and that of general manufacturing, such as Lundell dynamos and motors, etc., $206,181. The report notes the really remarkable success of the conduit system and emphasizes the popularity of the iron armored conduit, in which the underwriters now permit freely the use of two conductors to the single tube, against which they fought so long. The company counts confidently on a large development of its conduit business the current year. During 1895, the company expects to advance its power generator and railway inventions, for which the times are now so ripe, and the new capital it is securing is to be used partly along that line. Under existing conditions the capital and obligations for patents, etc., of the company have represented a total of $1,575.00. This it is proposed to convert into $1,000,000 common stock and $500,000 cumulative preferred 7 per cent., leaving also $100,000 cash in the treasury. As the earnings of the past year were somewhat better than the rate of 6 per cent. on $1,500,000, the preferred should easily earn its dividend and leave a wide margin for the common stock. It is understood that this plan is being carried through. The officers for the current year are: *Directors*, elected January 17, 1895, Edward H. Johnson, Carl Schurz, Henry Steers, John Markle, Allan C. Bakewell, Josiah C. Reiff, Coe D. Tows, Edwin T. Greenfield, Everett W. Little. *Officers:* Edward H. Johnson, president; Everett W. Little, vice-president and general manager; Chas. P. Geddes, secretary and treasurer; Robert Lundell, electrician.

STANDARD UNDERGROUND CABLE CO.

THE STANDARD UNDERGROUND CABLE COMPANY held its annual meeting on Tuesday, January 22nd, 1895, and the old Board of Directors was re-elected as follows:—George Westinghouse, Jr., Mark W. Watson, J. W. Dalzell. James H. Willock, John B. Jackson, George B. Hill, John Moorhead, Jr., Robert Pitcairn, Joseph W. Marsh.

The gross business for the year 1894 was $963,464.00, which is an excess of $101,551.00 over the business for the year 1893. Out of the net profits for the year, the Company paid four quarterly dividends of 1½ % each, or $60,000.00 in all. The capital stock is $1,000.000 fully paid up, with a surplus of $581,000. The Company has practically no debts, except for current purchases for the months of December and January.

The prospects for the year 1895 are very good, the unfilled orders carried over from last year amounted to $58,000, in addition to which the third annual contract with the Philadelphia Traction Company for lead covered underground feeders has just been secured, besides an annual contract with an Electric Light & Power Co. for electric light cables, which two contracts give promise of at least $250,000 worth of business during the year. The Philadelphia Traction Company has bought from the Standard Underground Cable Company about $700,000.00 worth of feeder cables (principally underground, but also some overhead) in the last three years.

During the past year, the Cable Company has furnished many underground feeders for street railways, and had at one time four separate large contracts under construction simultaneously, two in Philadelphia, one in Boston, and one in Rochester, New York. In order to relieve the crowded condition of its factories, the Company erected during the past year a two story and basement building adjacent to its old factories, at the corner of 16th Street and Allegheny Valley Railway, in the City of Pittsburg, and this building will be ready for occupancy in a few weeks. The Company also expects to erect early this Spring, a large four story and basement building on the site of one of its present Factory buildings.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JAN. 22, 1895.

Alarms and Signals:—

Railway Signal, J. Wayland, Newark, N. J., 532,930. Filed May 23, 1894.

Signal Box, B. J. Noyes, Boston, Mass., 532,014. Filed May 27, 1892.

A single box in which the mere act of opening the door sends in the signal.

Dynamos and Motors:—

Magnetic Brush Holder, J. O. Henry, Westfield, N. J., 532,782. Filed Dec. 11, 1894.

The carbon brushes are pressed against the commutator by the iron core of a solenoid coil. The pressure being proportional to the work done by the machine.

Electric Fan Motor, J. L. Ketcher, New York, 532,789. Filed Apl. 26, 1894.

A pair of fans mounted on a vertical spindle so as to distribute the air in a horizontal plane.

Armature for Dynamo Electric Machines or Motors, H. Lemp, Lynn, Mass., 532,795. Filed Mch. 29, 1890.

A special form of laminated armature construction provided with ventilating holes.

Machine for Winding Armature Coils, J. Riddell, Schenectady, N. Y., 532,821. Filed Oct. 19, 1894.

Regulator for Dynamo Electric Machines, L. Bell, Boston, Mass., 532,861. Filed Dec. 18, 1893.

Regulation is effected by varying the speed of a separate exciter inversely to the variations of speed of the armature in the main generator.

Commutator Brush, M. R. Hirsh, Milwaukee, Wis., 533,038. Filed May 31, 1894.

Consists of a brush in which sheets of metal are repeatedly bent to a block of the desired shape and the interstices filled with graphite and the whole enclosed in a coating of metal.

Galvanic Batteries:—

Galvanic Battery, C. B. Schoenmehl, Waterbury, Conn., 532,826. Filed Nov. 14, 1893.

A series of cylindrical carbons inserted in an insulating cover with a metal cast within recesses so as to hold the carbons in position and to connect them electrically.

Lamps and Appurtenances:—

Incandescent Lamp, M. H. Branin, Lynn, Mass., 532,760. Filed April 10, 1893.

A method of mounting leading in wires in which the filament support has a flanged end so as to bring the seal between the filament support and the neck of the bulb upon the outside of the neck so as to form an anchorage for the bulb and the lamp collar.

Measurement:—

Electric Meter, E. Thomson, Swampscott, Mass, 532,839. Filed Aug. 10, 1894.

An electrolytic meter in which the principle of the overset balance is employed, the tipping being done by the liberated gases.

Miscellaneous:—

Electric Safety Device, C. T. Penton, C. C. Gartland & P. J. Casserly, Buffalo, N. Y., 532,814 Filed Feb. 2, 1894.

A spark gap arrangement which acts as a protector for crossed or grounded arc circuits.

Electric Welding Apparatus, E. Thomson, Lynn, Mass., 532,838. Filed Aug. 13, 1889.

The invention consists in constructing a number of clamps in series so that they may all be used together or independently while being supplied with current from the same source.

Electric Alarm Mail Box, E. C. T. Belding, Chicago, Ill, 532,860. Filed Feb. 17, 1894.

Electric Stove, C. E. Roehl, St. Joseph, Mo., 532,909. Filed Jan. 4, 1894.

Improvement on the same inventor's patent No. 491,628.

Railways and Appliances:—

Electrical Conductor, E. D. Lewis, Savona, N. Y., 532,796. Filed June 16, 1894.

A trolley wire insulated except at its lower end where it makes contact with the wheel.

Trolley Wheel, B. O. Paine, Millbury, Mass., 532,812. Filed June 11, 1894.

Specially designed to follow the curves and switches and unevenness in the trolley wire.

Trolley Breaker, W. B. Potter, Schenectady, N. Y., 532,905. Filed Aug. 4, 1894.

A trolley breaker provided with a magnetic arc extinguisher by which it may be made shorter without affecting the insulation of the sections.

Telephones:—

Call Generator Connection, F. B. Cook, Chicago, Ill., 532,769. Filed Nov. 27, 1894.

Telephone Transmitter, W. A. Mason, Sumter, S. C., 532,979. Filed Oct. 26, 1894.

The microphone carbon cylinder rests in a bearing having sharp circumferential edges.

Telephone Switching Apparatus and Circuit, J. J. O'Connell, Chicago, Ill., 533,015. Filed May 1, 1894.

A special arrangement of circuits for trunk lines connecting sub-exchanges.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE QUAST GAS AND GASOLINE ENGINE.

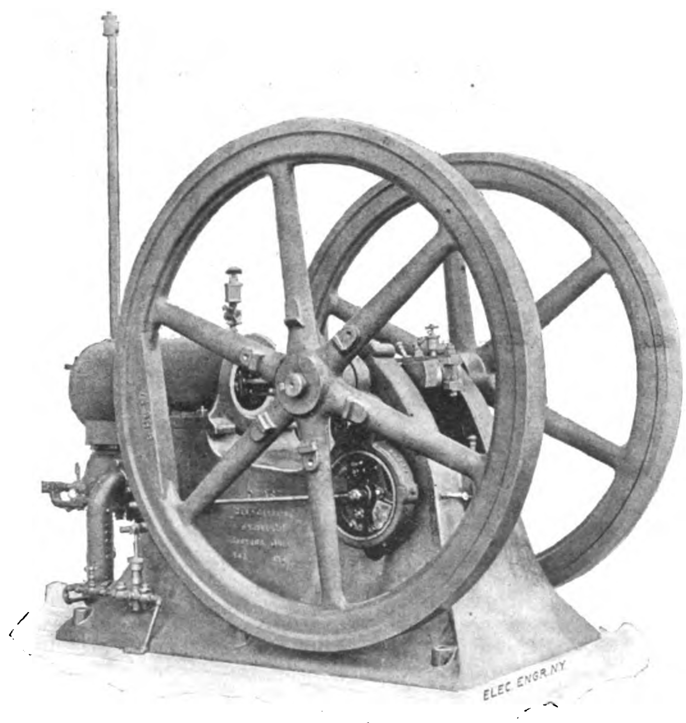
THE gas engine is comparatively new, yet since the year 1868 the cost of working has been reduced to one-sixth. To-day large gas and gasoline engines are successfully operated, some as high as 825 H. P. and soon internal combustion engines will be used in places where at present they are deemed impracticable.

Some of our modern gas engines, of larger sizes, have reduced the gas consumption to 18 feet per indicated horse power per hour, and the only drawback is the difficulty experienced by some, in obtaining a uniform speed of rotation,—a difficulty arising from the irregularity of explosions. The accompanying illustration, represents the Quast gas and gasoline engine, in which an explosion takes place at every other revolution, but the force of the explosion is regulated by a governor, which controls the amount of gas entering the cylinder. The engine operates on the well-known four-cycle principle.

The novelty in this engine is that there is but one valve, which accommodates both the suction and exhaust. It is of the rotating type, being automatically oiled and operated in such a manner that cleaning, grinding and re-grinding is not necessary.

The ignition of the compressed charge in the cylinder is effected by an electric spark. The Quast igniter consists of two small cells, which are especially constructed for this purpose. The spark is so strong and effective that so far, the speed of the engine has not been high enough to cause it to fail to ignite, although the engine, a 12 brake horse power, was running 950 revolutions a minute, exploding every other revolution. There is no smell to the igniting device and the chemicals of the cells need not be replenished for two years, but the cells have to be connected to an electric circuit, either incandescent or arc, for about three hours, every six months, which can be easily done. The life of the cells is about six years.

A small oil pump, worked and controlled by the governor,



THE QUAST GAS AND GASOLINE ENGINE.

draws gasoline from the oil tank under ground to the engine and forces it into the air mixer, no vaporizer being used; this takes place only during the out-stroke of the engine piston when it is drawing in a charge. Owing to the valve and igniting arrangement the engine can be run with safety at a very high speed and shows great regularity. Various tests were made with this engine which gave a gasoline consumption of $\frac{5}{8}$ of a gallon per horse power per 10 hours. One of these tests lasted three days.

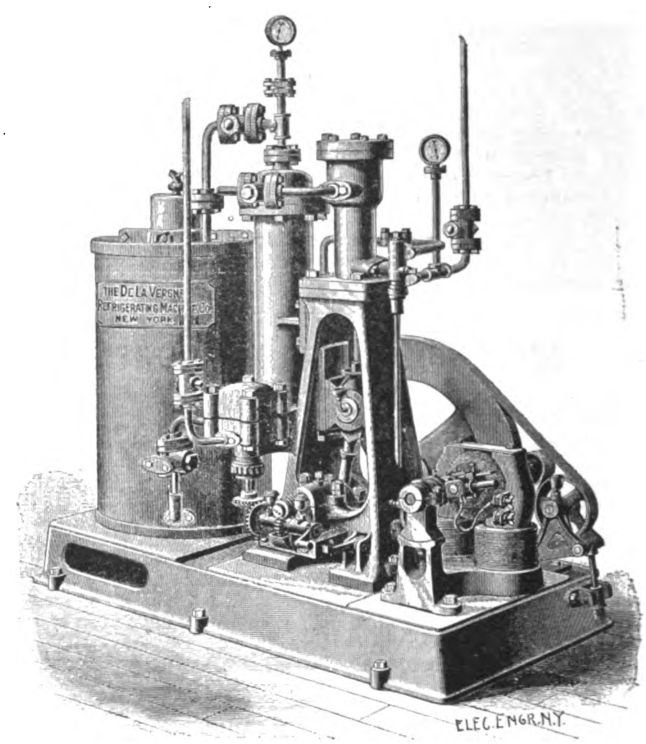
Efficiency, economy, quiet and smooth running, general reliability, combined with simplicity and neatness of design are the chief points claimed for it. The engine is started without any delay, and the speed and the point of ignition are regulated without stopping.

For electric lighting, the Quast engine may well be placed among the first, as practical tests have proven its steadiness and high rate of speed. Electricians lay stress upon these qualifications in engines offered for the lighting field, and this engine has filled the want, because built with special reference to it.

The inventor had years of experience, in the gas engine line, and it has been his aim to place on the market an engine which can be guaranteed, sold at a moderate price and filling all requirements of an electric light engine. The engine is manufactured by the Quast Gas and Gasoline Engine Co. of Bucyrus, Ohio.

AN ELECTRICALLY DRIVEN ICE MACHINE.

A very clever application of the electric motor to ice machinery has been recently made by the De La Vergne Refrigerating Machine Co., of this city. The apparatus, which is in daily oper-



AN ELECTRICALLY DRIVEN ICE MACHINE.

ation in the office window of Sargent & Lundy, Monadnock Building, Chicago, will produce about 300 pounds of ice in twenty-four hours, and is shown in the accompanying illustration. If used for cooling it will keep at a temperature of from 36° to 40° Fahrenheit 350 to 400 cubic feet of space, for instance a refrigerator of 10 x 5 x 7 feet. This is equal to the cooling capacity of ½ ton of ice every 24 hours. The water required, is 30 to 40 gallons an hour, and the floor space occupied by the machine, is 3 x 4 feet.

As will be seen, the motor is mounted directly on the bed plate of the machine to which it is belted. It is a Crocker-Wheeler motor of one H. P. capacity running at a speed of 1050 revolutions per minute.

A similar combination to the one described is now in operation at the Pan-American Exhibit, Industrial Building, 43d street and Lexington avenue, this city. It requires absolutely no attention other than turning the starting switch on in the morning and off in the evening. The device is said to be coming rapidly into popular favor.

KEYSTONE MOTORS.

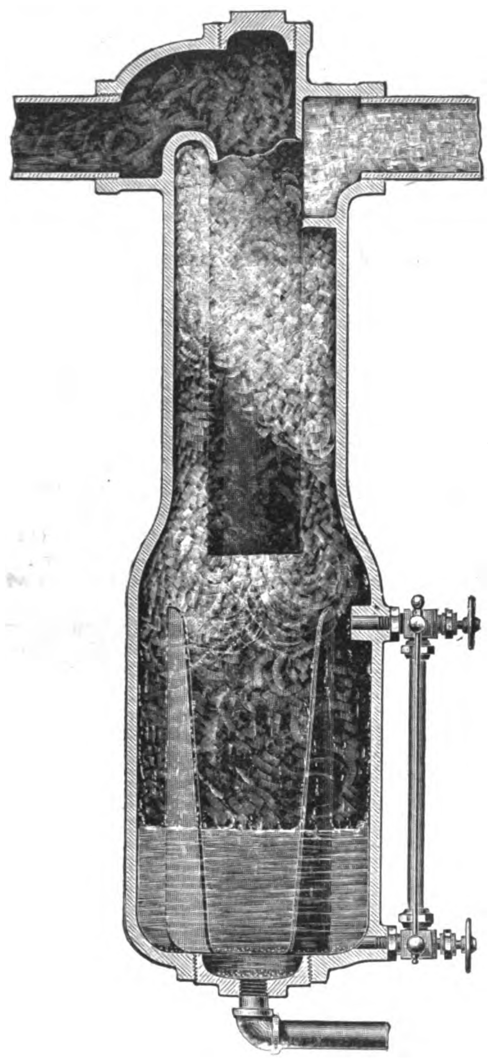
The Keystone Electric Company, says the Erie, Pa., *Herald*, opened the new year with prospects of the busiest time they have ever had. They have just closed a $50,000 contract with the Smith-Hill Elevator Company, of Quincy, Ill., for electric motors, the contract to be completed this year. It contemplates the construction and delivery of one hundred motors. Mr. C. G. Comstock, of the Smith-Hill Co. has been in the city while the terms and conditions of the contract were adjusted and agreed to. Last year the Keystone Company supplied the Smith-Hill Company with 58 motors and the almost doubling of the order for this year is gratifying evidence of the thoroughly reliable service rendered by the Keystone motors, and is also to be taken as evidence that productive industry is on the up grade.

GENETT AIR BRAKES IN DEMAND.

Mr. E. J. Wessels, general manager of the Genett Air Brake Co. of 31-33 Wall street, informs us that he has just closed a contract for 8 brake equipments for Bristol, England, each electric car on the new road there being supplied with a set. The company has also recently closed a contract for a good many brakes in the west. The manufacturing part of the business has been transferred from Chicago to the East in order that the demand in the East and abroad, can be better dealt with and things be generally expedited.

TEST OF STRATTON IMPROVED SEPARATOR.

Prof. R. C. Carpenter, of the Department of Experimental Engineering, Cornell University, has just concluded a test of the Stratton improved separator, illustrated in the accompanying engraving, which is of special interest to steam users, showing,



The Stratton Improved Separator.

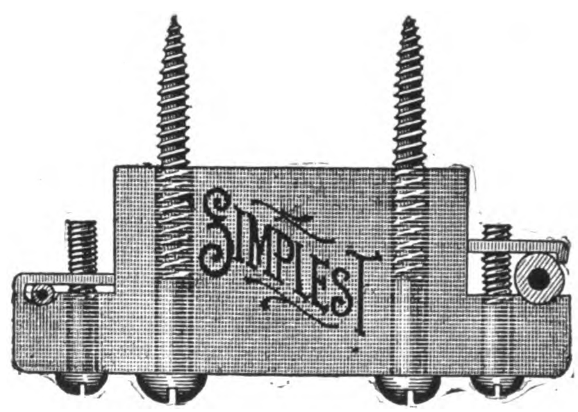
as it does, that means are at hand for obtaining practically absolutely dry steam in the engine cylinder with boilers priming badly. For this test the steam pipe leading to the Stratton separator was surrounded for a portion of its length with a jacket which could be filled with water to any desired height. The purpose of the water jacket being to condense as great a per cent. of the steam as possible. The discharge of steam from the separator was led to a surface condenser, where it was condensed and the amount carefully weighed. The drip of water discharged from the separator was led to a barrel standing on a pair of scales and accurate weighings were made of the water taken out from the steam by the separator. A throttling calorimeter was placed in the steam pipe directly after the steam left the separator and pressure gauges were placed either side of the separator. The following is the general summary of the results: The steam supplied to the separator contained moisture, the percentage of which varied from a little over 5 to nearly 21. That discharged from the separator was in every case nearly dry, it containing in every instance less than 1 per cent. of moisture. The separator was worked up to its full capacity and there was no appreciable reduction of pressure. The summary of the results of different runs is given in the appended table. During these runs the water was kept at a constant height in the separator.

No. of Run.	Pressure of Steam.	Moisture in Steam Supplied Separator Per Cent.	Moisture in Steam leaving Separator Per Cent.	Quality of Steam leaving Separator Per Cent of Dry Steam.
1	60	6.55	0.95	99.05
2	61	17.2	0.94	99.06
3	62	15.31	0.9	99.1
4	76	15.6	0.6	99.4
5	61	20.9	0.8	99.2

The Goubert Manufacturing Co., New York City, are the sole manufacturers of the Stratton Improved Separator.

THE "SIMPLEST" WIRING CLEAT.

The accompanying illustration shows a wiring cleat recently introduced by the Electric Heat Alarm Co., of 145 High street, Boston, and called by them the "Simplest" because of eight excellent reasons, as follows: It is in one piece; it anchors the wire; there is no breakage; it does not cut or bend the wire; it can be put up independent of the wire; it does not interfere with



The "Simplest" Wiring Cleat.

the perfect insulation of the wire; it is practical for nearly all sizes of wire, and it will bind two sizes of wire at the same time.

The cleat was designed and has been patented by L. H. Des Isles, foreman of the company's shop.

FIXTURES FOR THE ROCKFORD, ILL., POST OFFICE.

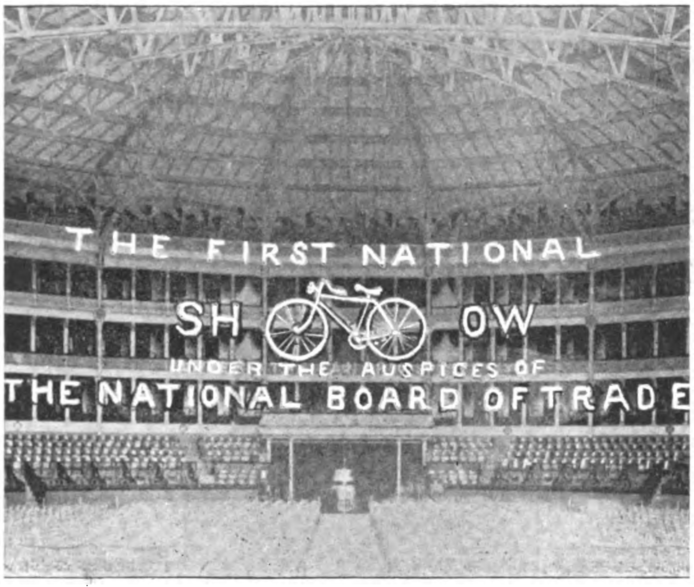
Bids were opened at the office of the Supervising Architect of the Treasury Department on Jan. 8, 1895, for all the labor and materials required for the interior finish, plumbing, conduits for electric wires, for the United States Post Office building at Rockford, Ill. The following is a list of the bids submitted: C. H. Porter, Rockford, Ill., $38,947; time 108 days. Johnston W. Monteith, Rockford, Ill., $18,630; time 6 months. G. Maffioli, Rockford, Ill., $14,197; time 5 months. Dawson Construction Co., Toledo, O., $12,497; time 1,440 hours. E. D. Briggs, Peoria, Ill., $17,910.29; time 6 months. Schureman & Cook, Rockford, Ill., $18,038; time Aug. 1, 1895. Chas. W. Gindele, Chicago, Ill., $12,950; time 5 months. E. Earnshow & Sons, Chicago, Ill., $16,400; time 6 months. Jas. E. Shover, Indianapolis, Ind., $14,850; time 6 months. E. F. Gobel, Chicago, Ill., $16,471; time 6 months. M. Yeager & Son, Danville, Ill., $14,664; time 150 working days. L. L. Leach & Son, Chicago, Ill., $14,393; time 4 months.

Packard Transformers.—The demand for Packard transformers continues brisk and the Electric Appliance Company state that where they have installed the original equipment of transformers they are always sure of the orders for renewals and have yet to record the first case where the "Packard" has been displaced.

ELECTRICITY AT THE NEW YORK CYCLE SHOW.

The "First National Exhibit of Cycles," or, more concisely, the Cycle Show, held last week at Madison Square Garden, was the finest exhibition of the kind yet held in this country. Manufacturers were out in force and vied with each other to make their booths attractive. Electric lights were freely used throughout the great hall in the decoration of the booths and, while nothing elaborate had been attempted by the exhibitors, some very pretty effects were produced.

Perhaps the most striking was a large wheel, 70 inches in diameter, completely covered with the nickel plated cyclometers of the New York Standard Watch Co., of 11 John street, and carrying around its edge red, white and blue incandescent lamps. To show the operation of their cyclometers, this company had a bicycle with one of its wheels belted to a ⅛ H. P. C. & C. motor and running at a speed of a mile in 1 minute and 10 seconds. The Cyclone Combination Cycle Co., of 309 Broadway, this city, had



ELECTRIC SIGN AT THE NEW YORK CYCLE SHOW.

their booth prettily lighted and further beautified by a large sign on which appeared the words "The Dorsett" traced in miniature lamps.

The Bridgeport Gun Implement Co., of 313 and 315 Broadway, had a wheel equipped with their cyclometer run by a small Lundell motor, the motor pulley bearing upon the bicycle tire and running it by friction. Other exhibitors had small motors applied in one way or another to their wheels for similar demonstration purposes.

The only electric bicycle lantern shown was that of the M. & M. Electric Company of 140 Washington street, this city. It consists of a rectangular battery box in the front of which is fixed a miniature lamp and reflector. It is claimed to give five C. P. for four hours on one charge.

A special feature of the exhibition was the electrical sign constructed by the Garden's electrical expert, Mr. Frank Martin, and shown in the accompanying illustration. This was 108 feet in length by 35 feet in width and contained 2192 lamps of a combined 29,147 candle power. The bicycle was 20 feet in length by 13 feet in height with wheels having a diameter of 8 feet. The diameter of the tires was 7 inches, the large gear 24 inches and the small one 8 inches. Colored lamps were artistically arranged for the different parts and as the wheels revolved the effect was very striking. In the word "Show" there were 95 lamps in the first letter, 105 in the second, 98 in the third and 132 in the fourth. In the bicycle itself there were 601 lamps and in the other letters in the sign 1161, making a total of 2192 lamps as before stated. This sign in itself required two motors of 2 horse power each to flash it. If equally distributed the lights in the sign would illuminate an area of 35,000 square feet. The background was of gold bronze, and the whole effect reminded one strongly of the artistic and elaborate results achieved at the World's Fair.

AN ELECTRIC BELL FOR STANIFORD LEDGE BUOY.

The Light House Board, through the Engineer, First Light House District, Boston, Mass., is inviting proposals until Feb. 7, 1895, for all the materials, labor and appliances for establishing an electric bell on Staniford Ledge Buoy, Portland Harbor, Maine. Prospective bidders may obtain additional particulars together with the necessary specifications and contract blanks by addressing W. R. Livermore, Engineer First Lighthouse District, Room, 142, P. O. Bldg., Boston, Mass.

WESTERN ELECTRIC COMPANY—A BIG CONTRACT.

On January 25, the Western Electric Company closed a contract with the City of Allegheny, Pa., for a complete City lighting plant, including 480 arc lamps, dynamos, station apparatus and everything except line construction; a very noteworthy order, obtained under severe competition.

NEW YORK NOTES.

THE NEW YORK ELECTRIC EXCHANGE has been incorporated in New Jersey by J. E. Blackmore, H. Blackmore and D. M. Mandrell, all of Newark. The capital stock is $100,000.

THE STOREY MOTOR AND TOOL CO., manufacturers of the Storey motor and dynamo, whose headquarters have heretofore been located in New York City, announces that hereafter its main office will be at the factory in Philadelphia, corner of York Street and Sedgeley Avenue. A New York office will, however, be maintained at 120 Liberty Street, with Mr. N. M. Garland in charge.

THE WHITE & CROSBY CO. did a neat piece of work last week, when in the middle of the ruin caused by the strike they took off the hands of the Atlantic Avenue line in Brooklyn the repair of its wrecked trolley circuits. The damage wrought maliciously was enormous but inside of 48 hours the repairing gangs, some of which were brought on specially from Baltimore had cleaned up things wonderfully, so that cars were soon running regularly on many routes.

THE ABENDROTH & ROOT MANUFACTURING COMPANY, 28 Cliff street, New York City, sole makers of the Root improved water-tube boiler and Root's spiral riveted pipe, find business good, and state that the outlook for the ensuing year is "A. No. 1." There has been a lively demand for their boiler from the South and West, for service in electric lighting and electric street railway plants. This is a class of work for which the Root boiler is especially well adapted, and for which it has become deservedly popular.

WESTERN NOTES.

THE MILWAUKEE DYNAMO CO. has been formed by W. A. Ehlman and others with a capital stock of $5,000.

THE E. S. KAROLY ELECTRICAL CONSTRUCTION CO. has been incorporated at Chicago by E. S. Karoly and others. The company will do a general electrical business and starts with a capital stock of $12,000.

MR. E. W. COOKE, the well known electrical engineer, is fitting up a suite of spacious offices at 1649-50-51 Monadnock Block, Chicago, where he will have charge of the western business of several first-class eastern concerns. Among the firms with whom Mr. Cooke has already arranged are the Mason Regulator Company of Boston, the Pecora Paint Company, Philadelphia, and Chas. E. Chapin, New York.

MR. FORÉE BAIN, the well known electrical engineer, has opened offices in suite 1657-58-59 Monadnock, Chicago. Mr. Bain is making a specialty of designing machinery in which electricity is applied to new uses to hasten and cheapen the process of manufacture. He will also act as expert in patent causes and carry on a general business in the line of consulting, testing, designing, etc. With his long experience in the field and his large personal acquaintance, Mr. Bain should have no difficulty in building up a large and profitable practice.

CONVENTION ECHOES FROM MILWAUKEE.

The following supplement the items and notes already printed on the convention at Milwaukee of the Northwestern Electric Association:

THE PEORIA AUTOMATIC FILTER CO. had an interesting exhibit of their patent automatic oil filter and purifier in charge of Mr. J. A. White, who gave a practical demonstration of the efficiency of the filter.

FOUR STOCKHOLDERS IN THE CHAS. E. GREGORY CO. was the inscription on a neatly printed half-tone plate, showing the pictures of the four junior Gregorys and which indicated in a happy manner that Mr. Gregory's efforts in building up the largest electrical trading business in the country are not for his individual benefit.

MR. CHANNING T. GAGE gave several demonstrations of the fire proof qualities of Salamander Wire, by passing sufficient current through samples of several makes of rubber covered wire to bring them to a red heat and destroying their insulation, the Salamander insulation remaining intact.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

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ELECTRIC LIGHTING IN MEXICO—THE PLANT OF THE AGUAS CALIENTES ELECTRIC LIGHT COMPANY.

BY

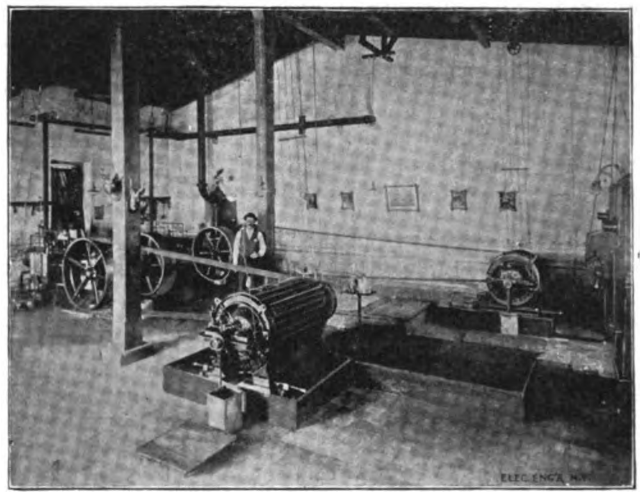
George Heli Guy.

AGUAS CALIENTES is one of the Mexican cities that few travelers on the Mexican Central Railway fail to stop at, and in their after memories of the place are pleasantly mingled wide, clean streets, quaint buildings and carved stonework; tropical plants and brilliant flowers; bathing houses and churches. Indeed, if cleanliness be next to godliness, the existence of the three large and crowded bathing houses of the city may have an intimate connection with the fact that it possesses twelve churches, about one to each three thousand of its inhabitants. Its legion of springs are of all temperatures, cold, tepid, and hot. The people bathe daily, and at all hours of the day; the well-to-do using the bath houses, and the poor availing themselves of the stone troughs that carry away the overflow. In fact, bathing is one of the two ruling passions of the mass of the citizens; the other is their love of the "fiesta." The Mexican will live for months on fare which to the most frugal dweller in a less genial climate would seem insufficient to keep body and soul together; but he must put up his little store of pesas against the feastday, for the bull fight must be seen, and he has to bet that his favorite

Aguas Calientes Electric Light Station.

matador will kill the bull at the first lunge; it is a physical impossibility for him to pass the gambling tables, which are an important feature of the holiday, without trying his luck, and the celebrations of each day would be incomplete without copious libations in pulque and mescal to the health of the patron saint of the feast. But during the fiesta the night must be made as the day, and hence it happens that there is an electric light plant at Aguas Calientes, which possesses the unique distinction of relying for its existence on the pleasure-seeking instinct of a people who would not move their hand to install it for merely business purposes. In fact, the fiesta makes the local electric light company, and, in return, the electric light gives the fiesta a brilliance and completeness unknown during the reign of the oil lamp.

The station of the Aguas Calientes Electric Light Company was erected in 1890 by the Interstate Gas & Waterworks Company, of St. Louis, Mo. It is situated near the line of the Mexican Central Railway Company, and about a mile from the point of the first distribution. The boiler



Interior of Aguas Calientes Station.

plant consists of two 100 H. P. boilers, made by the John O'Brien Co., St. Louis, 60 inches diameter, by 16 feet, with fifty 4-inch flues. The engines are two tandem combined McIntosh-Seymour, with an independent Blake condenser. These engines are 100 H. P. each, the high pressure being 9 and the low pressure 16 inches diameter, with 12 inch stroke, and working at 280 revolutions per minute. The generating plant consists of two Heisler long distance, slow speed alternating dynamos, having a capacity of 300 32 c. p. lights each, and running at 600 revolutions.

The company claims to have the best operated plant and the steadiest lights in the Republic of Mexico. The efficiency of the service is certainly attested by the fact that in four years the aggregate operating time lost has not exceeded 24 hours. The lines run on poles through the main thoroughfares. The streets are lit by incandescent lamps, with sheet iron reflectors. The object in this employment of the incandescent service is to adjust the light to the necessities of the streets, which are narrow and crooked, the buildings being low.

There is a municipal law to the effect that stores shall be closed at 10 o'clock, and as the business part of the city is deserted at 10.30, the commercial lighting is shut down at that time. One of the lighting contracts of the company is that of the handsome opera house, which seats 1,500 people. It has three galleries and a capacious auditorium, which is admirably lighted by the central station service. The installation consists of 65 32 c. p. lamps.

But all the street and commercial lighting put together would be insufficient to keep the station going. The earnings of the company for any particular month can be estimated with a fair degree of accuracy from the number of saints' days on the calendar. The station is so equipped as to supply churches with extra light at short notice, and often from 200 to 300 lamps are put into one church temporarily at a lucrative price. The six largest of the churches of the city are lighted by the company. At Christmas time large crowds poured into the Cathedral to witness the special illumination. In the centre of the altar was a life-sized figure of Christ. Radiating outward from this central figure were strips of silver gilt, and at the point of each of the radiations was a 16 c. p. lamp. An additional 200 lamps were employed in a large inscription of the word "Maria." The effect was striking, and the people were delighted.

But the time when the resources of the station are most severely taxed is the feast of San Marcos. The Mexicans are born gamblers, and San Marcos is the great gambling feast of the year. Between the 20th of April and the 10th of May, visitors flock into the city from all parts of the country to the number of 60,000 or 70,000, and among these there is a liberal admixture of American and European travelers. The city is given up to high revelry, and all gamble, from high to low, according to their financial capacity. The headquarters of the play is the Hotel de San Marcos, where special apartments are gorgeously fitted up with mirrors and upholstery, and brightly illuminated with novel lighting designs. Around the tables are to be seen the youth, beauty and wealth of Mexico, and the game goes on night and day. No nationality or sex seems exempt from the fascination of the hour, and it is amusing to see the fair visitors from the region north of the Mexican border, looking, at first, with an expression of horror at this picture of dissipation, and gradually succumbing to the influence of the place, and taking a hand at the game.

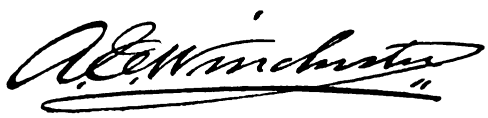
Aguas Calientes is justly proud of its handsome Plaza and its celebrated San Marcos Gardens, and during the fiesta these great promenades, thronged nightly, are brilliantly lighted. At the Gardens, temporary wires are run to light the paths, and many-colored lamps are festooned over the walks and through the rich and luxuriant foliage of the trees. In fact, the electric light is everywhere, and it has come to be a most material, if not indispensable element in the great festival.

The company are well satisfied with the results of their recognition of and provision for this peculiar local demand. Their interests are cared for in Mexico by Mr. Antonio Chavez, the diplomatic secretary, who transacts the company's business with the Government; and Mr. G. B. Armstrong, electrician and engineer, who has charge of the machinery and station. Mr. Armstrong is being temporarily assisted by Mr. Harro Harrsen, of St. Louis, from which city Mr. Armstrong also hails.

Electric lighting in Mexico promises to develop into a great industry. One of its most serious drawbacks is the difficulty of procuring cheap and good fuel. Coal is in many places at an almost prohibitive price. The cheapest kind of Sabinas coal stands, for instance, at Aguas Calientes at $14.66 a ton, and this is of poor quality. The station, therefore, falls back on wood for fuel, and brings oak and mesquita from Ronconderomas, about 40 miles away, over the Mexican Central. This wood costs 7½ cents for an aroba, or say, 250 lbs. The wood yard necessarily entails the maintenance of quite a gang of laborers, and those who are not in the secret are likely to puzzle in vain over the extraordinary fact that Mr. Armstrong has had the same set of men for four years. The explanation is that the men are paid every evening for the day's work. If the peon versed in city ways had a week's wages in hand, he would not come back until he spent it, if at all, and the station would lose his services. What he receives in the evening he will drink and gamble away before morning, and the next day he is at work again, to find the wherewithal for another night's enjoyment. Mr. Armstrong's plan works to a charm; the labor is constant, business goes on smoothly, and everything in the little station looks clean and bright and workmanlike.

WHY MUNICIPAL PLANTS SUCCEED AND WHY THEY FAIL.

BY



The description of the South Norwalk municipal electric lighting plant which appeared in The Electrical Engineer of Jan. 30, and the success there attained, naturally brings up the question of the advisability of municipalities owning and operating their own electric lighting plants. The writer, being one of the Board of Electric Light Commissioners of South Norwalk has had abundant opportunities for study and observation on this question and wishes to state at the outset that he is not an advocate of municipal electric plants as well as public ownership of all other public institutions *except under the most favorable conditions*, which are seldom met with except in theory.

The idea is a very broad one with vast possibilities, but it is sad as it is true that in its applied state it is not always a success.

It is daily becoming more and more apparent that municipal electric plants are gaining in numbers even in the face of constant reports of failure in that line; which reports, by the way, to be just, are often exaggerated and circulated by parties interested in private plants.

The primary reason for this increase in municipal plants is largely due to schemers who, by glowing promises, make a business of obtaining valuable franchises from progressive little cities and in return establish a cheaply constructed plant with the expectation of unloading the stock at a handsome profit on the citizens. If the citizens do not bite, the schemers find a plant on their hands that must in some way be made to pay, but one which is fast becoming uneconomical as its "surface newness" wears off owing to low grade apparatus or careless construction. Necessary repairs constantly increase in consequence.

The stock being then owned by the non-residents they have no other interest in the plant than to curtail the cost of operation at the expense of good service, for which the public is paying. Gradually protests arise from the dissatisfied people which are met with a deaf ear by the owners who believe themselves safely protected by a broad charter giving them a monopoly of the business. They may reply to the people's just demands by saying that the plant is not paying or aver that it is merely being operated for sweet charity's sake, or try to make them believe that they are supplying a better service at lower rates than any other plant in existence.

It is then as a last resort that the people begin to talk of a municipal plant. An instance of this character resulted in the establishment of a municipal plant by the city of South Norwalk in which case it is gratifying to say success has been achieved after a thorough trial.

The great enemies of municipal electric plants are politics and partisanship, and success can never be expected until such plants are conducted on strictly business principles after the manner and with the same care as private concerns. This is true of all other city work. When such a time arrives,—which I trust is not too remote,—then there will be no reason why cities cannot operate electric plants and supply lights for the public with more economy than private plants can afford, because it is obvious that the profit that would otherwise go to the private plant will

remain in the pockets of the citizens in the shape of reduced taxes.

After all, a municipal plant is practically speaking the same as a private plant inasmuch as all the citizens are stockholders in it, and if they wish success it rests with them to select with as great care as would any well organized business concern, those who are to establish it and thereafter appoint only men who are fully qualified and willing to manage it on an honest business basis, such as they would adopt in conducting their own affairs. But keep politics and party favoritism entirely out of the question.

A DYNAMO SAFETY DEVICE FOR ABNORMAL POTENTIAL.

Much damage has been done to electrical machinery due to grounds and crosses, and when these occur it is not always readily ascertained whether the fault is in the machine or on the external circuit. A simple piece of apparatus intended to protect dynamos as well as to locate the trouble has recently been devised by Messrs. C. T. Penton, C. C. Gartland and P. J. Casserly of Buffalo, which is illustrated in the accompanying engravings.

The idea involved in the safety device is to form an auxiliary broken circuit secured to the field of the machine at one end and to the frame at its other end, Fig. 1. The break in the circuit is provided with carbon points which may be adjusted to and from each other so as to regulate the resistance of the auxiliary circuit and also to cause the current to arc, when passing from one carbon-point to the other.

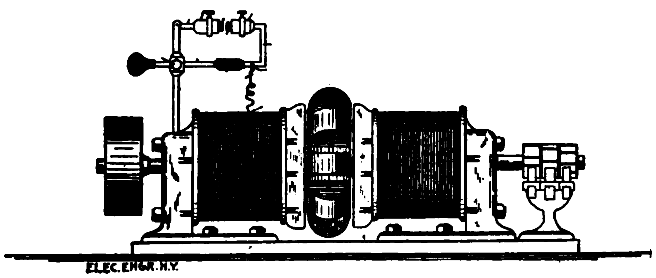


Fig. 1.—Dynamo Safety Device.

As long as the machine is carrying its normal electromotive force or within the variance provided for by the resistance caused in the break of the auxiliary circuit the apparatus will remain inactive, but should the potential increase beyond the normal, current will pass through the conductor B and A, Fig. 2, to the carbon point C′ and arcing to the carbon point C pass to the frame of the machine. The arcing between the carbon points will indicate that there is an increase of electromotive force in the circuit passing to the frame of the machine. The machine is then immediately stopped by the operator. It can now be ascertained where the trouble has occurred by throwing the carbon point C to its vertical position and making an electrical contact from any part of the machine frame to the brushes of the machine. Should a current exist in this conductor, which can be ascertained by causing the current to arc in its passage to the brush, the operator will know that the insulation of the machine has become punctured; but should the conductor from the frame of the machine to the brush remain dead it indicates that the trouble has been caused by the grounding or crossing of the circuit outside of the station.

The frequent occurrence of such trouble especially in cities where electric lighting and trolley systems are both used has made it almost essential for corporations to place lightning arresters at intervals along their circuit. These however are found insufficient and without a provision for abnormal potential upon the machine itself the insulation will be punctured, while when a machine is equipped with the apparatus described an auxiliary circuit which offers a less resistance than the insulation of the machine is always ready to take the abnormal charge and prevent the insulation from being destroyed.

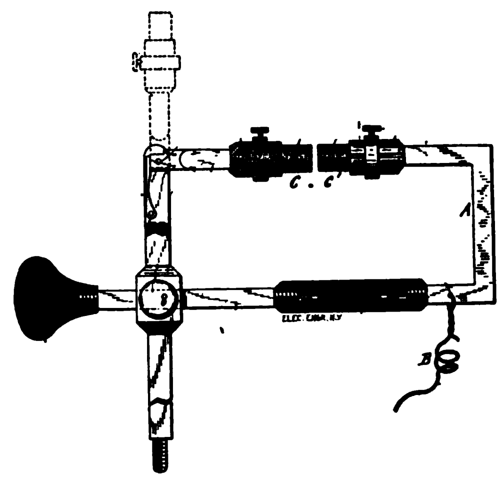


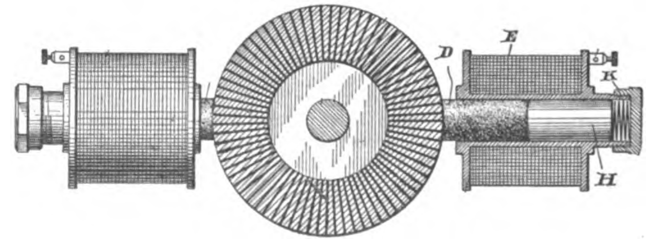
Fig. 2.—Dynamo Safety Device.

HENRY'S MAGNETIC BRUSH HOLDER.

In the operation of dynamo-electric machinery and particularly of electric motors, it has been customary to press the brushes against the commutator only by spring pressure, and this independently of the amount of work being performed, or current delivered. This is objectionable, for although the conductivity is largely proportional to the pressure, and particularly so with carbon contacts, an excess of pressure where only small current is delivered acts to increase friction, to cut the commutator and wear out the brushes, and in the case of motors, particularly in street-car work, to make a disagreeable screeching noise, besides acting as a more or less efficient brake, and thus decreasing the commercial efficiency of the motor.

To obviate these difficulties, Mr. John C. Henry, the electric railway inventor, of Westfield, N. J., has conceived the idea of pressing the brushes against the commutator with a force proportional to the load on the motor, and the manner in which this is carried out is shown in the accompanying engraving.

The carbon brush D, it will be noted, is placed within solenoid E, and pressed forward by the iron core H. A light spring K is just sufficiently strong to give a contact between brush and commutator capable of allowing the current required to start the machine to pass. As the work, and hence the current increases, the iron core presses the brush into closer contact with the commutator and on the other hand relieves the pressure as the work diminishes.



Henry's Magnetic Brush Holder.

Electrical Execution.—A bill has been introduced in the West Virginia Legislature providing for the infliction of the death sentence by electricity.

CASES OF SHOCK BY STATIC DISCHARGE.

BY

Jno. C. Henry

I noticed recently in one of the electrical papers an editorial and some correspondence concerning "Death from an Electric Shock" referring to a case in Demerara where a man was killed by the current over a 52 volt circuit from an alternating current transformer.

A few months ago a friend of mine in Westfield, N. J., was badly shocked under very similar conditions. His residence was wired for 50 volts. The lamps burned all night from a 1,000 volt transformer before and after the occurrence. He was standing on earth in the basement and wearing thin slippers, he undertook to turn on the light and thinks he only touched the insulated lamp switch ; the flexible wires leading to this lamp were evidently grounded by contact with the hot air pipes. He was knocked down and his fingers slightly burned. My first impression was, that it was a scare from but 50 volts under favorable conditions. This conclusion excited so much indignation that in an apologetical way I suggested another which was that he had received a static discharge from the core of the converter. I believe the last to be the true one, and I think that the European practice of grounding the converter cores should be insisted upon in American installations. While I have no doubt it would be difficult to repeat this condenser effect, I think there may be times when it is liable to occur in most forms of translating apparatus.

I have seen a man knocked over by contact with the core of a Gramme form of armature when the coils were being tested with a harmless magneto.

In the early days of electric railroading I experimented with a form of controller where the circuit was broken between the armature and the track rails. On several different occasions, when the cars were standing *with the circuit broken,* the motorman observed a large flash, and upon examination found the armature grounded. In those cases the armature core had been carefully insulated from its supports; they however had been exposed to heavy fogs during the night, and sweated considerably when put to work in the morning.

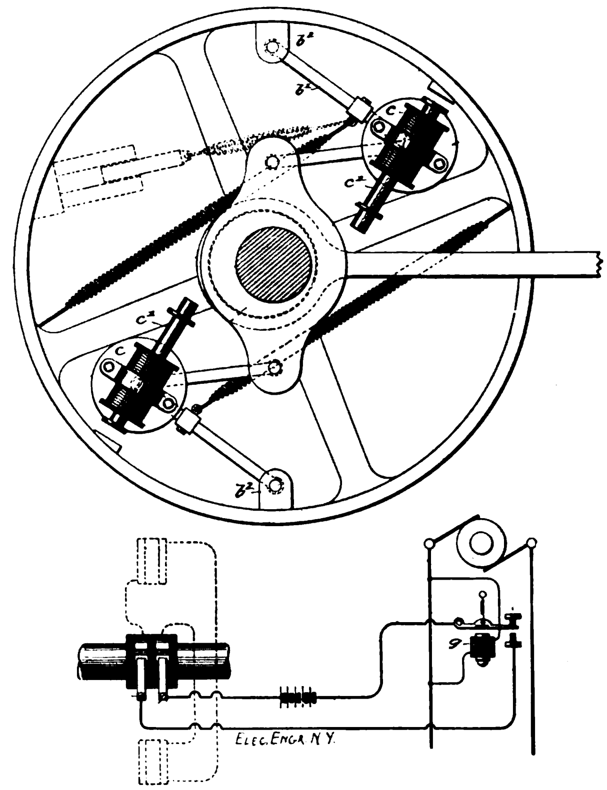
ELECTRIC POWER TRANSMISSION AT THE TROLLHATTA WATERFALLS, SWEDEN.

In connection with the projected large power transmission from the Trollhätta Waterfalls for account of the Swedish State, a serious dispute has arisen as to ownership of these vast falls. The Government plan comprises the formation of a reservoir at the upper end of the Gullön Island, so constructed that only one of the previously existing water mills will lose any power. The Government proposal itself is of considerable magnitude, and is the outcome of exhaustive preparatory labors, the committee having been at work for several years. The water power, which the State controls, is calculated at 40.000 horse-power and it is proposed to utilize 20,000 effective horse-power for two different installations. At the Gullön there is first to be built a power transmission station, which is to have 10,000 horse-power at its disposal, requiring for this purpose 74 cubic metres of water per second from the Gullö and Toppörenden streams. Having passed the uppermost Gullö waterfall, the water is conveyed into a kind of reservoir, blasted out of the rock, and which will supply a system of turbines, the water rushing down through a tunnel, blasted in the rock under the Gullö and the two Toppö islands, and terminating at the lower end of Stora Toppö. The length of this tunnel is about 770 ft., the height of fall from the in-take of the water to the exit of the tunnel will be rather more than 50 ft., and the effective fall for the turbines 48 ft. With an aggregate water consumption of 74 cubic metres per second, evenly divided between 10 turbines, and a yield of 72.5 per cent., there should be over 10,000 horse-power available. The installation comprises 11 turbines, of which the one is a reserve, and the turbines are to work independently of each other. Alternate current generators and transformers will then produce a current, the tension of which is calculated at 15,000 volts.

THE MELOTT ELECTRIC ENGINE GOVERNOR.

An ingenious electric governor for steam engines has recently been devised by Chester B. Melott, of Roundout, N. Y., and is shown in the accompanying illustrations. It has been recently claimed that, in the case of engines operating dynamos, magnetic attraction has interfered with the action of the governor balls and prevented the proper regulation of the engine. In Mr. Melott's invention, on the other hand, the action of the balls is supplemented by magnetic attraction. He attaches to each ball an electromagnet c, of the solenoid type, which is provided with a loose soft iron core c' which stands in a position tangent to the centre b^2, Fig. 1. The attraction of the magnet causes the core to be drawn through the spool until the centre of each coincides, and this movement is taken advantage of by adjusting the parts so that the head of the core must press against the rim of the wheel at the point c^2 and force the magnet and weight toward the centre of the wheel before the centre of the core can coincide with the centre of the magnet. If the circuit of the magnets is closed at the very moment when additional load is thrown upon the engine, the force of the magnets will act to throw the weights inward and thus shift the shaft to give the engine more steam before the centrifugal force will allow the weights to move inward. Thus the engine will be able to take up the increased load more quickly.

The magnet g Fig. 2, responds to variations in the current of



Figs. 1 and 2.—The Melott Electric Engine Governor.

the main dynamo circuit. When the current rises to a certain point this magnet becomes energized and closes the local circuit through the governor magnets. These magnets then become energized and quickly force the weights toward the centre of the shaft of the fly wheel and adjust the valve with the engine.

TECHNOLOGY AT CORNELL.

An eminent European scholar, Professor Ritter of Germany, who spent several months in this country, first at the Chicago Exposition and later studying American technical schools, has come to the conclusion that the Americans have outdone Europeans in the field of technological education, at least as regards its practical bearings. The technical branches are believed by Professor Ritter to be less complete and solid on the theoretical side in the United States than in Germany, but he sets opposite this inferiority the "truly grand achievements in engineering and machine construction in the United States. The Americans have not only mastered the technical sciences, mathematics and jurisprudence, but have given form to distinct faculties of the sciences of engineering. So far as regards instruction in mechanical engineering, Cornell University of Ithaca, N. Y. stands at the head of American Institutes."

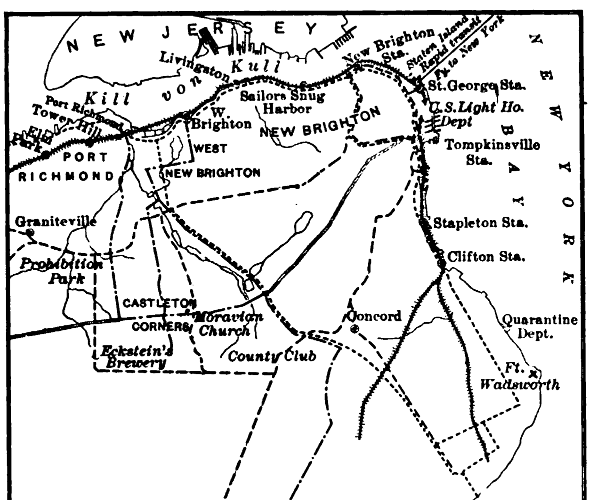
ELECTRIC TRANSPORTATION DEPARTMENT.

THE ELECTRIC RAILWAY DEVELOPMENT OF STATEN ISLAND.

BY CHAS. H. COCHRANE.

The future of Staten Island, so far as it is dependent for development upon the building of new electric railways, and the electrification of existing street roads, is in a very complicated condition. About the only thing that is absolutely certain is that numerous trolley lines will be built within a short period by some company or corporation; and perhaps several companies will obtain the coveted privileges.

Of the numerous corporations in the field, the one already occupying the greatest territory is the Staten Island Electric Co., operating the Belt line, now in the hands of a receiver, James D. Van Hoevenberg, of 189 Broadway, N. Y. Although legally in a bad way, the company is in reality very much alive, being in the control of the Thomas syndicate, which purchased the Staten Island ferry last summer, and came to some understanding with the Staten Island Rapid Transit Company for the development of Staten Island traffic and transportation. The Thomas syndicate design reorganizing the existing Belt line, and operating it upon the single trolley system, and building a variety of new lines as feeders to the present system and the ferry. This would be all very agreeable to the people of the Island were it not that the Staten Island Interior Railroad Company desire to build a system of roads that will in many cases parallel the Belt line. Herman



Elec. Engineer

EXISTING AND PROPOSED ELECTRIC ROADS ON STATEN ISLAND.

Bergholtz is president of this company and Erastus Wiman is attorney and agent. They have very recently pooled their interests with the Staten Island Terminal Electric Company (of which Cornelius M. Timpson is president, and Erastus Wiman projector), which proposes building an endless or circle road of three miles in New Brighton, to connect all lines with the ferries at St. George.

The Rapid Transit Company is a considerable factor in the fight, since new roads centering at St. George will deprive the railway of some traffic. This is especially true of the Belt line, which proposes to parallel the Rapid Transit road over a very large part of its route.

The Staten Island Midland Railway Company is a recent creation, arising from a consolidation of the so-called West Brighton road and the Prohibition Park Electric Railway. They are arranging to connect their routes and form a horseshoe that will act as a feeder to the Rapid Transit road at West New Brighton and Port Richmond.

The situation therefore is that the Rapid Transit road now controls the steam railway of the Island, and has an understanding with the Thomas syndicate that controls the ferry and the Belt line of horse railways on the Island. The Midland Railway Co. controls, and practically has permission to extend feeders to the Rapid Transit road. The S. I. Interior R. R. Company and the Staten Island Terminal Company have a scheme of internal development that exists at present only on paper, but they are backed by large capital, and pushed by the indefatigable Erastus Wiman, who has done so much for the development of the Island that he still has the confidence of the property holders, and a wide sympathetic support.

The accompanying map shows the routes now existing and proposed.

It will be seen that the Rapid Transit railway skirts the northern and eastern shores of the Island. The old Belt line (now S. I. Electric Co.—Thomas syndicate) controls the ten miles of horse railway track from Fort Wadsworth, in the town of Southfield, through Middletown, New Brighton and Northfield, as far as Howland's Hook, on the Kill von Kull. They are now applying to the different Boards of Trustees of villages for permission to make the following extensions: (1) From Tompkinsville up the Turnpike to the Clove road, across the Clove road, down Fingerboard road, Sand lane and Old Town road to the Seaside boulevard, to connect West New Brighton with South Beach. (2) From Fort Wadsworth, along Richmond avenue and Sea avenue to the Old Town road, to connect the line on the East shore with South Beach. (3) A loop on Sand lane and Ocean avenue. (4) A loop at New Brighton to connect the present Belt line at Tompkinsville and at New Brighton station. It should be observed that this last loop occupies practically the same territory that the Staten Island Terminal Co. desire for their three-mile loop. The advantages that the S. I. Electric Co. urge upon the property owners is that their relations with the Ferry Company are such that they can give a ten cent fare from any point of their lines to the Battery in New York. They are not as yet committed to any system of power, but it is understood that they will use the single trolley overhead system.

The Staten Island Interior R. R. Company proposes to connect with the Terminal Company's loop in New Brighton, and run to Prohibition Park via Forest avenue; also a southerly line from the Terminal Company's belt, along Targee street to Concord, with a spur to South Beach, and a westerly line across country to Slosson avenue, and northward to Forest avenue. If this goes through they purpose later to make extensions (1) from Prohibition Park to Elizabethport; (2) from Prohibition Park to Linoleumville; and (3) from Concord, via Ocean Terrace and the hill route, to Richmond.

The Staten Island Terminal Electric Company proposes to build a terminal road along the shore from Tompkinsville to New Brighton, past the Ferry landing at St. George, and to complete a circle by running around the base of the hills up Jersey street, around to Tompkinsville. This will afford, in a distance of three miles, a ring of trackage at any point of which electric roads can enter, on perfect equality of terms. They purpose having immediate access to the ferry landing, and to guarantee a five cent fare, not only to passengers on their route, but to those on all other lines seeking terminals thereon. Its capital stock is $50,000. Its president, Cornelius F. Timpson, of West New Brighton, who for twenty-five years was cashier of the Continental bank, is the largest owner of dwelling properties in New Brighton. He and a few others have guaranteed to take all the stock that the people of New Brighton do not want themselves, and the company popularizes its proposition by offering a percentage of the gross receipts to the village of New Brighton, and providing for the creation of a Board of Control by the village Trustees, said board to consist of the president of the village, the county judge, and the county and village engineers. It is proposed that this Board of Control shall have full powers to adjudicate all differences between the rival companies, and settle all disputes or complaints on the part of the public as to accommodation, detention, etc.

While the terminal idea is quite new, and perhaps not thoroughly digested, yet at this time the general opinion of Staten Islanders toward it may be said to be favorable. It affords a happy solution of a very complicated question, and its fairness and probable popularity are such that the Thomas syndicate has made a similar proposition offering the use of its tracks, if it secures the franchise to complete the circuit at the terminal (it already occupies half the circle), for the use of any other company desiring to approach the ferry, on payment of a fair rental.

The S. I. Midland Railway Company now owning the so called West Brighton horse-railway from West Brighton, via Broadway, Castleton avenue, Columbia street and the Manor road to Four Corners and Eckstein's brewery, and the electric road from Port Richmond, along Jewett avenue to Prohibition Park, are to enlarge the power house at the latter place, and as soon as the frost is out of the ground in the spring will extend their tracks from Castleton corners over the Richmond Turnpike and Jewett avenue, connecting (by the irony of fate as well as by an electric current) Prohibition Park and Eckstein's brewery! Electric power will be applied to the whole road, and the residents of West Brighton will be brought within reach of the numerous

summer attractions at the Prohibition Park auditorium, while it is promised that the service will be improved, with later trips in the evening than at present. For the purpose of establishing a connection between the north and the south shore of the Island and thus connect with the Stapleton branch of the Staten Island Midland Railway Company running from Stapleton to the intersection of the Richmond road with the Clove road, the company contemplates the building of two extensions; one from the intersection of Castleton avenue and Broadway through Broadway and the Clove road to the Richmond road, while the other proposed extension is to start at Four Corners and to run over the Richmond Turnpike to the intersection of the Little Clove road, thence along the Little Clove road until the Clove road extension from Broadway, West Brighton, to Concord, is reached. This will give virtually two routes between the north and south shore. The further intention of the Staten Island Midland Company is to extend its line electrically equipped from Concord to the County seat at Richmond with a branch from New Dorp to New Dorp Beach.

The Midland Company is fortunate in that there is no special opposition to any of its plans. The Rapid Transit Company is favorable to them because it feeds their line, and the competition with the Belt line and the Interior railroad is too remote to cut an active figure. But between the Staten Island Electric Company, (backed partially by the Ferry company), and the Staten Island Interior Railroad Company (associated with the Staten Island Terminal Electric Company), there is war to the knife. The two latter companies are the outgrowth of Erastus Wiman's efforts. It will be remembered that Mr. Wiman made the Rapid Transit Company what it is, and that when the Thomas Syndicate gained control last year, they put Mr. Wiman to the humiliation of seeing his name taken off one of the boats, which had plied under that title for ten years. The contest is therefore one of personal antagonism as well as business rivalry.

Mr. Timpson and Mr. Wiman undoubtedly scored a point in the introduction of the Terminal scheme, in which all parties interested are invited to pool their issues. The Interior Railroad Company, which first sought exclusive privileges at St. George and New Brighton, have agreed to turn over all their property consents to the Terminal Company, and to become their customers on equal terms with other roads. If the Terminal company is given the privileges asked Mr. Timpson says he will have the road completed by the coming Fourth of July, provided the necessary property consents are afforded by March 1.

At the present time the rival companies are devoting their energies to hearings before the Boards of Trustees of the different villages interested, and oratorical thunder is being used to show why each should have that which they ask.

The recent suggestion made by Engineer Edward P. Doyle that the County raise money by bonds, and build all the roads desired, and then lease them for short terms to private companies, appears to have fallen flat because there is no one interested to push it. Probably it would be the best thing for the public, preventing any company from establishing a permanent monopoly. The next best thing appears to be the acceptance of one or the other of the terminal propositions giving the management to a Board of Control, and then allowing all companies to build lines as feeders as often and as long as they please.

It should be remarked that all the companies expect to make available a ten cent fare from any part of the Island to the Battery in New York. The Thomas syndicate intimate that this can be done only through their lines. This claim is disputed by the other lines, and as proof they cite an actual arrangement between the Midland Company and the Rapid Transit Company, in which Mr. Gannon, the latter's superintendent, undertakes to carry the public from any part of the Midland lines to New York for ten cents a head, the arrangement to be effective when the Midland Company has completed its horseshoe extension at West New Brighton and Port Richmond, and their electrification at Stapleton.

In regard to the Thomas Syndicate's contention that they are the only ten-cent people in the business, Mr. Wiman urges that there can be no discrimination of one common carrier above another, and that inasmuch as the Ferry Company is now a distinct corporation, separated entirely from the Rapid Transit Railroad Company, the Ferry company must carry passengers from other roads for five cents the same as it does for the Rapid Transit. He says also that neither the Ferry Company nor Rapid Transit Company can prevent either the Internal Railroad Company or the Terminal Company from building approaches direct to the Ferry landing, because the law expressly allows any company to build 1,000 feet of overhead track across the property of an existing company, and this is the very thing that either of the entering companies propose.

Against Mr. Wiman's position it is argued that the Staten Island Electric Company is really owned by the same parties that run the Ferry Co. (the Thomas syndicate), and that they have nine points of the law in their favor in already occupying most of the territory; that it is an open question whether they cannot make opposing roads pay more for ferry transportation than they charge themselves; that no other corporation can in any manner trespass on the Ferry landing, their nearest possible approach being about a block distant; and that the Thomas syndicate is the only corporation that really means business, having offered a $10,000 forfeit to begin work within 90 days of the time when the franchises are granted, and complete the improvements within a year.

The various local authorities are hampered and embarrassed in the making of decisions by the existence of the Belt line franchise. It must be admitted that the present service is bad. The property owners along its line are eager for its rehabilitation, while the residential owners are in many cases bitterly opposed to it. There are large stretches of property that refuse consent to a change of motive power. It is sure to have difficulty in obtaining permission for extensions that parallel the existing Rapid Transit road. Such extensions do not benefit the public at all, as the Rapid Transit Company now carries passengers for five cents, and no reduction of fares is reasonably possible.

As at present constituted the Rapid Transit Company gives a satisfactory service to the residents, running half hourly trains either way, through the greater part of the 24 hours. It has fixed charges of about $750 a day, and if any company is allowed to cut in to its traffic it can only recoup itself by reducing the quality of the service. This is so well known that the various village trustees will hardly do anything to injure that Company's business.

Still the Rapid Transit people are alive to the dangers of competition, and are hinting that they contemplate a change of motive power, from steam to electricity, with the idea of building various spur tracks into the interior of the Island, as feeders, and to develop the country.

The Terminal Company are now making hot war upon the Thomas Syndicate by offering the Trustees of the village of New Brighton, in return for the three-mile terminal route privilege, to enter into a contract to buy and extinguish the Belt line franchise, or, if that cannot be done to incur the cost of a suit by the Attorney General to extinguish the franchise for "non-user" where there are no tracks, and for inadequacy if property consents where there are tracks.

INSPECTION OF STEEL RAILS FOR ELECTRIC RAILWAYS.

BY H. LOWENHERZ, JR.

STEAM railway engineers have studied track construction for nearly half a century. Great advances have been made in the last ten years, and changes are still going on. This means that the present railroads are not perfect, are not final; yet withal, the steam railroad practice is the best guide in a general way for street railway men using electric systems to follow. It is a well-known fact that the rolling stock of electric street railways is heavier than that of the horse-car roads. The speeds in vogue on electric lines are also much greater. These two conditions must be met by heavier sections of rail, and high class steel in order to obtain long life and immunity from breakage. The elevated roads of New York City are beginning to use heavier sections than formerly, namely a 90 lb. rail in order to secure long life, which means less repairs.

The question of standard sections for steel rails for steam roads has been fully considered by the American Society of Civil Engineers, as well as the standardization of tests for rails. As has been said above it would be advisable for electric railway men to adopt the practice of steam roads in almost all particulars and to adapt their standard sections to the conditions existing on urban and interurban trains. Rails rarely break under the steady motion of the wheel load. It is only when, owing to some irregularity in the track or rolling stock, they are required to take up the energy of an impact, that they are strained to their utmost. This is one of the frequent causes of broken rail.

Now let us look at the wearing qualities of rails. It is well known by all who have made a study of steel rail mixtures that a rail high in carbon will wear the longest. It is also well known that to get too much carbon renders the rail brittle and liable to break. Chief engineers, therefore, usually specify a rail comparatively low in carbon, lest the mill exceed the amount specified and thus get too near the danger line. The amount of carbon in each case should be made proportionate to the weight of the rail to get the best results. As pertinent to the subject we may also quote the following from an editorial in the *Engineering News* of Jan. 24, 1895, on the subject of rail joints and double-truck cars.

"The increased size, weight and speed of street cars consequent upon the adoption of cable and electric traction have made it necessary to improve the running gear, so as to give steadiness of motion combined with ample adhesive powers. The lurching motion of long cars, carried on four wheels with a short rigid wheel base is often very severe when the cars are running at high speed, and this motion is not only very unpleasant to the passengers, but also very injurious to the track, owing to the pounding of the wheels upon the rail. In fact, it is said that on

the electric lines built in Philadelphia last year the result of this pounding is already to be seen at the rail-joints of routes on which four wheel cars are run at speed."

This recalls the question of angle plates at rail joints. It is the custom with the steel mills to furnish a soft, low carbon steel for angle plates. This material has a very low elastic limit and tensile strength and easily takes a set under a slight blow on the track. The following results are taken from a number of tests made during the summer of 1894 on the N. Y. Central & H. R. R. R. 80 lb. section, and show the difference between a good rail steel, and the angle plate steel furnished by the mill:

	Tensile Strength.	Elastic Limit.	Behavior under Impact.
Rail Steel..........	120,000	60,000	Stood 2,000 lbs. falling 20 ft.
Angle Plate Steel..	57,000	30,000	Broke under 2,000 lbs. falling 6 ft.

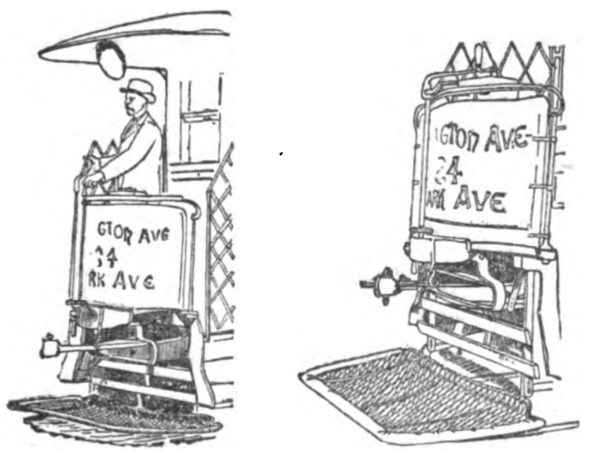
It is evident from the above that a part of the track which is weak by design is made of inferior metal and this is the cause of much difficulty in keeping up the joints. The remedy is to specify a higher carbon steel. This may explain why the Philadelphia rail joints have suffered. With an inspector to make chemical as well as physical tests, the mills can be made to live up to any desired percentage of carbon, sulphur, phosphorus and silicon. Of course, there is a great chance of variation in all these elements when one considers that iron in a molten state is particularly liable to absorb sulphur and phosphorus from the fuel. As long as no inspector is appointed to make tests, companies contracting for high class rails cannot expect to receive the best material invariably as the mills as a rule cannot be depended upon to reject their own bad material when it means a loss of hundreds of dollars to do so. This emphasizes the desirability of putting all material contracted for to a strict scientific inspection.

THE YOST STREET CAR FENDER.

Bills have recently been introduced in the Missouri and Illinois Legislatures to compel street railway companies to place fenders on their cars, and an ordinance to the same effect is now before the St. Louis city council to go into effect on May 1. A good beginning in this direction has already been made by the Lundell Railway Co., of St. Louis which has equipped some of its cars on the Park Ave. division with an ingenious fender designed by Mr. C. S. Yost, of that city.

The Yost Car fender which is illustrated in the accompanying engravings Figs. 1 and 2 is automatically self adjusting in all respects except the placing in position by the motorman in case of accident.

The details of its construction are shown in Fig. 3. As will be seen, the screen is suspended by four upright hangers, A, B, two of which are connected to a rocker shaft, and two to side sills of platform. The fender when at rest is under the side sills of the platform, and when in action is projected about three feet in front of dash board. The four hangers support the two screen bars,



Figs. 1 and 2.—The Yost Street Car Fender.

the two front hangers having slotted holes through which connecting bolts of the screen bars play. The rocker shaft has a short lever which is connected with a coil spring C bolted to the car sill in the rear of the rocker shaft, and with a 3/8in. chain D bolted to the controlling shaft on the dash. The spring performs the duty of pulling the fender back to rest after action; the chain connects to the controlling shaft on the dash board and is pulled forward by the motorman turning the shaft through the agency of a hand lever G which he pulls towards him about 16 inches. This action of the chain in being drawn forward projects the fender down and forward to the track.

The fender when thrust forward is held in that position by a spring dog on the platform which connects with the controlling shaft ratchet. When the motorman wishes to release the fender

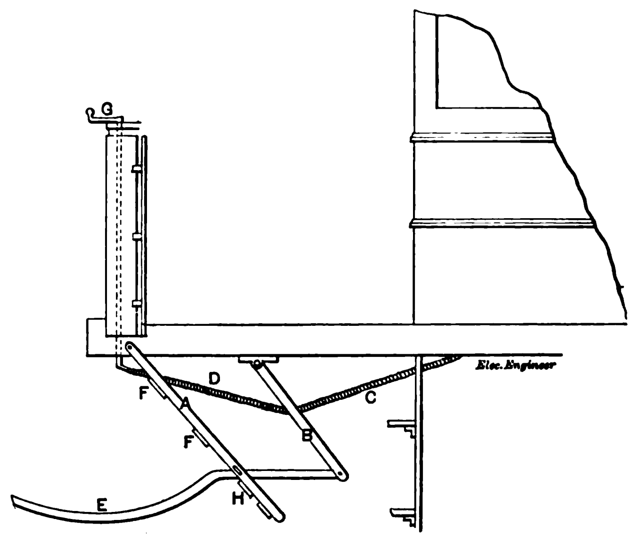


Fig. 3.—The Yost Street Car Fender.

he pushes the spring dog forward with his foot and the fender instantly returns to the resting position through the agency of the coil spring. The two screen bars support a wire screen which runs forward 3 feet from the forward hangers. The edge of this screen on front and sides is padded with heavy rubber hose. Back of the screen and extending below some five inches are two slats H to prevent any object going underneath the car when the fender is at rest; there are also two slots above the screen F to prevent any object from going through above the fender.

The fender is simple in construction being made of cast steel, wire netting and wood and consists of fifteen parts only, all of which are strong and durably made. It is so constructed as to stand the wear and tear of street railway service and still retain its working capacity.

REPORT OF THE BOARD OF EXPERTS ON NEW YORK RAPID TRANSIT.

The New York City Board of Rapid Transit Railroad Commissioners met last week and received a report from the committee of experts appointed under a resolution of the board adopted Dec. 26, 1894. The committee's report confirms the estimates made in the plans of Mr. W. B. Parsons, chief engineer to the board; mentions various objections to his plans; suggests modifications; recommends electricity as the power to be used to acquire a speed of twenty-five miles an hour, with stations a half mile apart; proposes an arrangement for transfer tickets with the Metropolitan Traction Company, and recommends a four-track system, mostly elevated, between Ninety-second and One Hundred and Eighty-fifth Streets.

It recommends the Elm Street route instead of the Broadway route for the East side; suggests connections with the New-York Central Railroad's tracks along the river front, from both east and west side routes. The estimated cost for the routes suggested is $42,068,721, instead of $56,870,000 as estimated for the previous plans.

The report suggests a two-mile elevated extension from Fourth Avenue, north of Central Park, to Sixth Avenue, and thence through the blocks to the Harlem River, at a cost of $2,500,000; also an extension of the west side lines by elevated road from One Hundred and Eighty-fifth Street to King's Bridge, to connect with the New-York Central Railroad at a cost of $1,500,000; also to have the New-York Central's tracks on the west side extended by elevated structure to connect with the main line, for the purpose of carrying freight.

As neither of the plans suggested will give immediate and adequate relief, the report states that the Manhattan Company should be compelled to lay additional tracks on its elevated structures upon which to run express trains entirely around the city. A third track is proposed for the west side roads below Fifty-third Street, two additional tracks on the Second Avenue structure, and also two additional tracks on the west side structure above Fifty-third Street.

As to the use of electricity, the Board say first in regard to the new rapid transit system :—

It is recommended to use a form of construction for subways and viaducts that will allow of the construction at first of two tracks only, where desirable, because trains composed of cars equipped with electric motors can be run at a speed of seventeen miles per hour, with stations 1,500 feet apart, or at a speed of twenty-five miles per hour with stations half a mile apart, and with this kind of motor trains containing more than five cars can be run at the maximum speed, thus making the traffic capacity of two tracks with electric traction, very much greater than that of the present elevated roads with steam power.

Further, with regard to the existing elevated system they say :—

If the improvements suggested to the Manhattan system shall be made, electric power should be substituted for steam as soon as practicable, because the removal of the locomotive engines will relieve the elevated system from its chief drawbacks. The speed of the local trains will be increased to seventeen miles per hour, and the rebuilding and strengthening, so far as may be necessary, of the structures, will remove any apprehensions as to their stability.

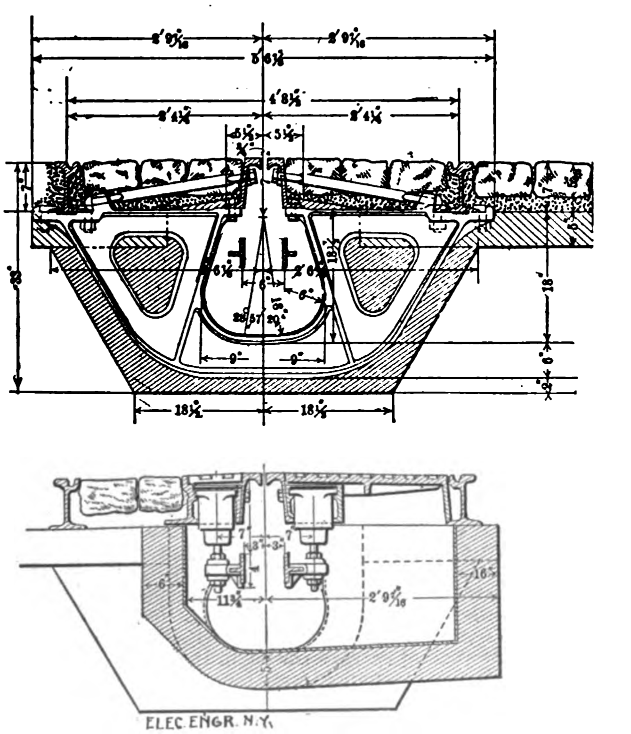
The figures submitted are as follows :—

Route.	Tracks.	Subway Miles.	Viaduct Miles.	Cost.
South Ferry to City Hall, via Broadway	2	1.00	..	$2,250,000
City Hall to Fourteenth Street, via New Elm Street	4	1.85	..	6,200,000
Fourteenth Street to Twenty-fifth Street, via Broadway	*2	.59	..	863,500
Fourteenth Street to Twenty-third Street, via Fourth Avenue	4	.44	..	1,200,320
Twenty-third Street to Twenty-fifth Street, via Twenty-third Street and Madison Square	2	.24	..	465,300
Twenty-fifth Street to One Hundred and Eighty-fifth Street, via Broadway and Boulevard	4	5.59	2.65	15,235,460
				$26,214,580
East Side.				
Twenty-third Street to Forty-fourth Street, via Fourth Avenue	4	1.08	..	2,382,698
Forty-fourth Street to Mott Haven, via Fourth Avenue	2	2.67	2.32	7,873,718
				$37,470,996
Forty-second Street Branch, via Forty-second Street	2	.50	..	768,750
Total		18.91	4.97	$38,239,746
Ten per cent. for terminals and side tracks				3,823,975
Grand total				$42,063,721

* Express.

ELECTRIC CONDUIT OF THE METROPOLITAN RAILROAD, WASHINGTON, D. C.

The Metropolitan Railroad, of Washington, at present operated by horses is compelled by Act of Congress to abandon their use by Aug. 2, and is now actively preparing to put down an electric



Figs. 1 and 2.—The Washington, D. C., Electric Conduit.

conduit. The general design of the conduit, which is shown in the accompanying engravings is similar to that employed in cable practice.

The working conductors are iron T-bars 4" deep and placed 6" apart, supported by malleable castings. As shown in Fig. 2, these latter are supported by rods which are fixed in large porcelain insulators that hang downwards from either side of the slot rail and spaced 13 ft. 6 in. apart. It will be noticed that this vertical suspension differs from the side attachment employed at Buda-Pest and also from the method to be employed on the Lenox Ave. road now building in New York in which the insulators are fixed vertically but rest on the bottom of the conduit. The feed wires will be carried in terra cotta conduits laid between the tracks.

The potential will be higher than that heretofore employed in conduit railway work, 500 volts being the standard, with a maximum drop of 50 volts, or 10 per cent.

The power plant will contain three 400 H. P. cross compound engines built by the Providence Steam Engine Co., direct connected to a like number of 300 K. W. General Electric Generators.

Eight miles of this conduit road will be installed in the spring, beginning with the 9th St. Line, and if this proves successful the F. Street Line will be changed over next year. The conduit we may add, is the design of Mr. A. N. Connett, chief engineer of the Metropolitan Railroad.

THE TROLLEY-STEAM COMPETITION IN NEW ENGLAND.

First Vice-President John Hall of the Consolidated road (New York, New Haven & Hartford) spoke as follows recently in regard to trolley competition : "First," said he, "this corporation is not opposed to electrical railways per se. We recognize the popular side of the question, and we believe that the time may come when advances in science will render it practicable to employ electricity as the motive power for railways in general. We have not antagonized the chartering of electrical railways which would directly compete with us. The Consolidated has a broad and fair policy in this respect. You will remember that the corporation has nearly 1,700 miles of track, and that its stockholders' interests foot up in dollars an enormous sum. Of course this vast property must be jealously guarded.

"Our disposition to tolerate competing electrical roads is an evidence of the company's fairness. For short distances the trolleys have cut into our passenger receipts. We have taken off some trains because of trolley competition. There is a twelve-mile branch between New Bedford and Fall River that is paralleled by a trolley line, and we have taken off a daily train each way. Up in Massachusetts, between Northampton and Williamsburg, the competing trolley has taken much of the passenger traffic. There are other points along the lines where the competition is felt. We expect this, and still do not place ourselves in antagonism to the rival transportation concerns. According to indications the entire line between Springfield and New York will be paralleled by electrical lines. These companies run over public highways free of cost, and their construction is generally very inexpensive.

"Electricity bids fair to outdo steam in economy sooner or later. We are so keenly alive to the electrical system that we shall equip a branch to run by electricity as well as by steam during the coming summer. I refer to the Nantasket Beach line. We will test the matter by carrying the heavy excursion traffic by electricity. If the plan is successful, as it no doubt will be, we are in a position to use electricity on the main line between New Haven and New York. There will soon be completed four lines of track. Two of these can easily be provided with electrical power. With the perfect roadbed, heavy steel rails and stone ballast, cars may be moved at a rate of speed that would leave highway trolley cars far in the rear.

"There is, again, a favorable side to the developing of rival electrical roads. While those which directly parallel us compete injuriously for short distances, the lines running at lateral angles bring us new traffic. A trolley road running into new country four, six, ten or more miles away and communicating with our lines tends to increase our passengers. Thus we are justified in not antagonizing the cheap transportation plan.

"There is a great question involved, however, in connection with electrical roads that at present places us in direct antagonism with many of their promoters. It is the subject of grade crossings. To the crossing of our tracks on a grade by trolley lines we are unalterably opposed, and the entire energies of the corporation will be directed to prevent by every legal and proper means such crossing. The electrical railway companies are not as particular on this subject. Some of them are not permanent enterprises. Cheapness prevails in every point connected with them. Their projectors are so anxious to make money in floating their schemes that they entirely ignore even common prudence. The Consolidated road has expended and proposes to expend in the future millions of dollars to eliminate grade crossings along its lines. Nearly all its crossings are now safe; soon all will be. The whole tendency of railway management is to eliminate grade crossings. As soon as a railway company becomes prosperous it seeks to remove this danger as rapidly as is practicable.

"The points at which the trolley people now wish to expose us to peril are Fairfield avenue, Bridgeport ; in Bethel, and one in Meriden. There are also other grade crossings in contemplation.

We feel that we are only doing justice to the public, to say nothing of our own interests, when we oppose to the last these crossings. Our lines, some of them, teem with passing trains, many of which run at a very high rate of speed. A vehicle of the ordinary description, a carriage, a cart, or even a common horse-car, offers but little danger to an express train. But a heavy electric car loaded with forty or more passengers is altogether too formidable an impediment to be disregarded. The chances are that if struck by a train not only the occupants of the car would be killed or maimed, but the train would be derailed and its passengers also involved in the general ruin. Such an accident might, through no fault of ours, cost the corporation hundreds of thousands of dollars. The electrical current sometimes gives out suddenly. Imagine a loaded car stalled in the middle of one of our tracks just on the time of a fast express.

"The trolley people are apparently willing to assume any risk to their passengers in order to save themselves money. Here in Connecticut the general law forbids grade crossings except by special consent of the Railway Commission. The electric railway people have obtained special charters allowing them the right of way to cross tracks at grade without the consent of the Commissioners. The subject went to the Superior Court, which granted an injunction against such crossing; but on appeal to the Supreme Court the latter decided, three to two, that the special acts superseded the general law."

STREET RAILWAY REAL ESTATE IN NEW ENGLAND.

A petition has been received by the Massachusetts Legislature from the Massachusetts Street Railway Association for legislation to enable street railway corporations to purchase, acquire, hold and improve land for parks or pleasure resorts and for the construction of buildings for purposes of amusement, such corporations to be allowed with the consent of the railroad commissioners to increase their capital stock and issue bonds for the purposes authorized by the act.

CONNECTICUT'S NEW GRADE CROSSING LAW.

The Connecticut grade crossing bill was signed by the governor Jan. 22, and becomes operative immediately. The first section provides that no electric, cable of horse railway shall hereafter be constructed across the tracks of any steam railway at grade; and no steam railway shall hereafter be constructed across the tracks of any electric, cable or horse railway at grade. At Bridgeport, Conn., the court has refused to dissolve the injunction restraining the Bridgeport Traction Co. from crossing the New York, New Haven & Hartford R. R., and the latter road has secured an injunction restraining the former from laying its tracks across the land owned by the railway company.

THE TRENTON, N. J. TROLLEY SYSTEM.

The entire passenger railway system of Trenton, under the deal effected practically passes into the management of Philadelphians. Thomas C. Barr, of Newark, who was elected president of the company, went to Newark about five years ago, and is now interested largely in passenger railways in that city. Mr. Barr was at one time president of the People's Passenger Railway Company, of this city. He will fill the office of President of the Trenton Passenger Railway Company temporarily. Henry C. Moore, now President of the People's Passenger Railway Company of Philadelphia, who has been elected General Manager of the Trenton Company, will also become President later.

THE SEDALIA & BROWN SPRINGS (MO.) ELECTRIC RAILWAY CO.

THIS road, incorporated last November will be about 3 miles long and will be in reality an extension of the Electric Railway, Light and Power Company's system. When finished it will afford a continuous route from Sedalia to Brown Springs, a famous health and pleasure resort. The new company has issued $80,000 of bonds for the road, improvement of the Springs, etc., and the Electric R. L. & P. Co. has guaranteed the bonds and leased the new road and will build and operate it in connection with its own. Building will be begun in Spring. The power house of the present road will furnish current for the new extension. Mr. D. C. Metaker is secretary of the company.

CONTRACTS PLACED BY THE DETROIT RAILWAY.

The officers of the Detroit Railway are pushing things with all their energy, and they feel quite confident that on July 4 they will be able to give the people of Detroit a ride on their loop line to Belle Isle. Most of the contracts have now been let, and the conditions are that delivery must be made according to contracts, so that the work can be rushed early in the spring. Vice-President Everett and Secretary Break are very busy and the following contracts were awarded: Furnishing of oak ties, Detroit, Lansing & Northern Railroad Co., and E. S. Porter, of the Lansing Spoke Co., 50,000 each; 75 motor trucks, J. G. Brill & Co., of Philadelphia; 75 combination car bodies, St. Louis Car Co.; 75 double equipments for 150 motors, Westinghouse Manufacturing Co., of Pittsburg. The company has not yet decided where to locate the power house, but the site will probably be fixed upon shortly.

ANOTHER TRACTION CO. FOR NEW YORK.

The People's Traction Company of the City of New York has been incorporated with a capital of $1,500,000. The company proposes to build and operate a street surface railroad to be twenty and one-half miles in length, and to be operated by any motive power other than steam. The termini are Willis avenue and East One Hundred and Thirty-fourth Street, East One Hundred and Forty-ninth Street at the Harlem River; Bungay Street, at the East River or Long Island Sound, Depot Place, High Bridge, at the tracks of the New York Central and Hudson River Railroad Company; Boston Post Road, at the Bronx River; Lafayette avenue, at the Bronx River. The Directors are Franklin A. Wilcox, Edward H. Hobbs, John A. Bensel, New York City; Martin J. Keogh of New Rochelle; Edward Hassett, Charles B. Hobbs, John Foley, Jr., Daniel F. Cohalan, and J. Clarence Davis.

THE TROLLEY IN BERGEN COUNTY, N. J.

The National Trolley Company has filed articles of incorporation in the county clerk's office of Bergen County, N. J. The capital stock is stated to be $50,000. Ex-Assemblyman Delos Culver of Jersey City is the president of the company. The company will operate under the charter of the New Jersey and New York Bridge Company and will establish electric roads between Fort Lee and Englewood and the latter place and Hackensack. The Bergen County Traction Company have plans to establish trolley roads over the same route and there may be a conflict between the two companies. Some time ago Mr. Culver established a trolley company to build a road between Rutherford and Carlstadt. There was another company at the time building a road over this route. A conflict was avoided by Mr. Culver being made a director of the other company. He disbanded his company.

AGAINST GRADE CROSSINGS IN NEW JERSEY.

A number of prominent men of Essex County, New Jersey, have appeared before the Committee on Railroads and Canals of the State Assembly, favoring the elevation of the railroad tracks in the City of Newark. City Counsel Riker of Newark said that he did not favor the bill for the elevation and depression of the tracks in its present form. He said that there were two dangerous crossings in Newark, one at Broad Street and the other at Market Street. The worst is the latter crossing. On one side of the tracks are 35,000 people and on the other side 165,000. They are all obliged to cross the tracks at grade. It is estimated that 1,500 trolley cars, carrying from fifty to sixty passengers each, daily cross these tracks. No attempt is made to enforce the city ordinance controlling the speed of trains, because it would make a continuous run of trains, and would block the whole city traffic. At the other end of the city there is the Delaware, Lackawanna and Western Railroad, over which 1,000 trolley cars pass daily, and 25,000 people pass daily. The people of Newark want the tracks elevated at once.

THE HEILMANN SYSTEM OF ELECTRIC TRACTION.

It is stated that the Compagnie de l'Ouest, on whose lines the trials of the Heilmann locomotive have taken place have agreed to rent two new locomotives as soon as they can be built. Meantime, as it is impossible to establish a regular service with the single locomotive now in use, it is suggested that it might be made to serve as a central station, and that the four-wheeled bogies could be used for hauling purposes, the current to be supplied by an overhead conductor. The two new locomotives will be of 1,500 H. P. each, capable of hauling from 200 to 250 tons at a speed of 62 miles an hour. The contract for the supply of the boilers, bogies, and water-tanks has been placed with the Sociétté des Anciens Etablissements Cail, that for the dynamos with Messrs. Brown, Boveri, & Co., and that for the steam-engines with Messrs. Willans and Robinson, of Thames Ditton, England. All these steps have been taken with the assistance of the railway company, to whose specification the contractors are working. At the time of entering into these contracts, the Heilmann Company took the opportunity of granting to Messrs. Brown, Boveri, & Co., for Switzerland, Germany, and Italy, and to Messrs. Willans and Robinson, for England, India, and the British colonies, the exclusive right of working the Heilmann patents in those countries respectively.

THE

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CONTENTS.

MR. CROMPTON'S INAUGURAL ADDRESS.

IN the election of Mr. Crompton to the presidency of the English Institution of Electrical Engineers, the members of that body, whether consciously or not, gave recognition to "practice" as against "theory" in electrical engineering. From the half-suppressed murmurings, which we have noted hitherto in our English contemporaries, we imagine that the recognition of a practical engineer was not a mere accident, and that the papers which have been read and the discussions thereon, before the Institution, have not served to satisfy fully a majority of the members. In his inaugural address, Mr. Crompton has justified the expectations of those who elected him, by devoting his attention largely to a summing up of the position in which the electrical engineer now finds himself after the sixteen years during which he may be considered to have had an actual professional existence. As no address of this kind nowadays appears to be complete without some reference to the nature of electricity, we are not surprised to find that Mr. Crompton also has his views on the subject, which, by the way, are eminently sensible. The word "electricity" conveys to Mr. Crompton's mind an agency which we use for producing action at a distance, an infinitely flexible connecting rod, by which we can transmit energy and reproduce it at a distance in any desired form. Although this can hardly be called a definition in the true sense of the word, it certainly affords an excellent mental picture and analogy, than which no better, perhaps, could be given for popular purposes, and which is eminently in keeping with Mr. Crompton's previous experience as a mechanical engineer. As between the laws of electricity and those of mechanics in their application to practical problems, Mr. Crompton points out that the former are simplicity itself compared with what the mechanical engineer had to master before he could deal with the design of any form of thermal engine, or even deal with the flow of liquids through pipes, and that, while the losses in dynamo and conductors are readily determinable, those of the thermal engine and the losses of liquids in pipes are extremely complex. Taking up the materials most generally employed by the electrical engineer, Mr. Crompton draws attention to the fact that we are still in need of the ideal insulating material, which shall fulfill the double requirement of mechanical strength combined with that of resisting change of temperature or absorption of moisture. He believes that it will still be many years before we will be able to predict with any certainty the value of the insulation employed in the distribution system of conductors, such as the built-in system, the draw-in system, the bare conductor system, etc. Mr. Crompton did not allow the occasion to pass without referring to what he considered one of the most important duties of the electrical engineer, and that was to bring about an equalization of the station load. Of course, the great disparity between the English winter and summer loads was due to geographical position, and would always exist so long as the major part of the energy was used for lighting purposes. The obvious remedy was to encourage its use for motive power and for heating and cooking. Strange to say, Mr. Crompton believed that at present it was a far easier matter to educate the English people to the advantages of using electricity for heating than to induce them to use motive power to any considerable extent. Inquiries which he had made among American electrical engineers proved that the largest part of the motor load on American central stations was devoted to uses which were likely to exist to an equal extent in London or any of the large English towns, and he hinted that a little more commercial enterprise among manufacturers of electric motors, and central stations, would bring about encouraging results in the increasing of the motor load. Among the domestic applications to which he referred was that of refrigeration by means of

electric motors, which, we think, might well be taken up by our own central station operators.

Touching on the more recent developments in the control of electric power, Mr. Crompton refers, at some length, to Mr. H. Ward Leonard's method, which admits of a variable ratio between the two factors of speed and torque with the highest efficiency, and he was convinced that it would solve many difficulties which had heretofore been encountered, both in stationary work and in electric railroading. On the subject of electric measuring instruments, Mr. Crompton expressed himself very forcibly in favor of the employment of the potentiometer method, in which the only calibrated portion, the slide wire, can be subjected to extremely rough treatment without altering the accuracy of the instrument to any material extent. As a long-time user of storage batteries, Mr. Crompton regretted that a dead set had been made against them by some members of the Institution. He claimed, however, that during the last five years the improvements in this type of apparatus had been quite as rapid as that of the advance in the construction of dynamo-electric machinery, and that, from his own knowledge, he could state that recent improvements had reduced the cost of maintenance to an equal extent. He believed that this improvement was largely attributable to the recognition of the fact that the slightest impurities acted detrimentally to the life of the cell; and, by the precautions now taken, that difficulty had disappeared.

In closing his address, Mr. Crompton stated it to be his duty to raise a note of warning against placing electric engineering works in the hands of very young engineers, whose experience had been a very short one, and he feared that the Institution itself was in some degree to blame for the state of affairs existing in England, owing to the fact that it had devoted its attention to thoroughly scientific matters and thrust into the background the more prosaic matters which must be studied by those who hope to deal thoroughly and economically with the varying conditions of electric supply. He expressed the fear that the interchange of ideas, the comparison of experience, the exchange of statistics, etc., existed chiefly among the older members of the profession, and, although they were most willing to impart what they knew to their younger brethren, they were, practically, never asked to communicate the results of their experience. The information, which Mr. Crompton here shows to be confined to so few, is that which our own National Electric Light Association was designed to disseminate, and it might not be out of place here to suggest to our English cousins the formation of a society based on the same lines. In this country, the management of the Institute of Electrical Engineers has great difficulty in keeping the mathematical papers within bounds; yet when it ventures on practical, useful, close-at-hand subjects, some one is sure to jump up and howl about improper "advertising."

ELECTRIC TRACTION ON STATEN ISLAND.

The article appearing in this issue on the electric railway situation upon Staten Island affords an excellent idea of the manner in which electric roads are now being pushed in every part of the country. As will be seen, there is a most interesting scramble going on for franchises and rights of way, while even the old steam road is to be converted under the new dispensation. When the best plan or a combination of the more feasible ones is carried out, Staten Island will be ripe for a development that has been long impending but which could not have arrived so quickly without the aid of electricity. A good deal of money will be spent in carrying through these schemes, but there is fair reason to expect a handsome return. In summer time, the Island is more and more a pleasure resort, and the new facilities for rapid transit will soon do much to increase its resident population not only along the shores, but in the pretty inland districts. It looks as though in a few months steam locomotives will be banished completely from the Island, whose whole future will then depend on electric traction.

THE END OF THE BROOKLYN STRIKE.

As was to be expected, the Brooklyn strike has run its length and failed ignobly, but not without the usual attempt to wreck the lines by violence and the tardy though effective intervention of the militia. It cannot be said that the strike developed a single new feature of electro-technical interest; on the contrary, the latest appliances of invention are again shown to be powerless before the aberrations of judgment and passion of poor humanity. The strikers strove with all their might to injure the street railway companies, and finding that brute force failed, they turned to the law, and are still turning. But so far as the object of the strike is concerned, no victory in the courts will now avail, for the strike is dead. If the men are to get better pay and easier hours—which everybody will wish them for that is what everybody wants—those boons must be secured by proper methods and the conciliation of that tremendous public opinion which now silently arbitrates all questions.

We regret to see that the idea of "getting back" at the companies still pervades the minds of some of the more embittered men. For example, a fight is being made in the courts on some of the lines because they have practically made all their cars mail carriers, thus placing them under the ægis of the government. Now it is obvious that the only difference this can make in a strike is that it acts to prevent the stoppage of the cars and forbids the use of violence against them under the severest penalties. It would have to be a complete cessation of service that would hinder the handling of the mails; so that even a sharp limitation of the number of U. S. mail cars would not hurt the companies in dealing with peaceable employees. But the companies and the government are ready and willing to have all the trolley mail cars they can get. The only possible conclusion therefore is that the strikers want "U. S. Mail Car" painted out in order to have a chance to be wreckers of property and to escape risk. We dislike putting it this way, but if this be not the interpretation of the legal proceedings, what is?

Last week at the meeting of an electrical body in Brooklyn, to discuss trolley car technique, two significant questions were asked from the audience. One was, how it was possible to damage the machinery in a power house by doing something to the motors on a car out on the line. The other was, whether it was feasible to explode a bomb or dynamite cartridge under a car by secretly diverting from the car a part of the current passing through it from the overhead wire to the track return. The lecturer of the evening, himself a working man who has made his way by mastering the problems of electric traction for his own satisfaction, declined firmly to answer any such questions. His interlocutors did not show up when inquired for at the end of the meeting. What is one to think of such an episode? "Green motormen" are simply an abhorrence, but if expertness is to find its opportunity in such deviltry as these questions imply, it is safer for the public they should remain green. Unhappily, it seems to be one of the perils of the civilization for which so many generations have worked so hard and so long that its highest achievements are susceptible of being thus aborted by ruthless hands and vicious intellects. We refuse utterly to believe that the great body of trained and skillful workmen have at heart any sympathy with movements to destroy property and endanger life, for no matter what casual fortunes may be made, the workmen are the great gainers by every inventive economy of material, time and effort; and we think they know it.

TELEPHONY.

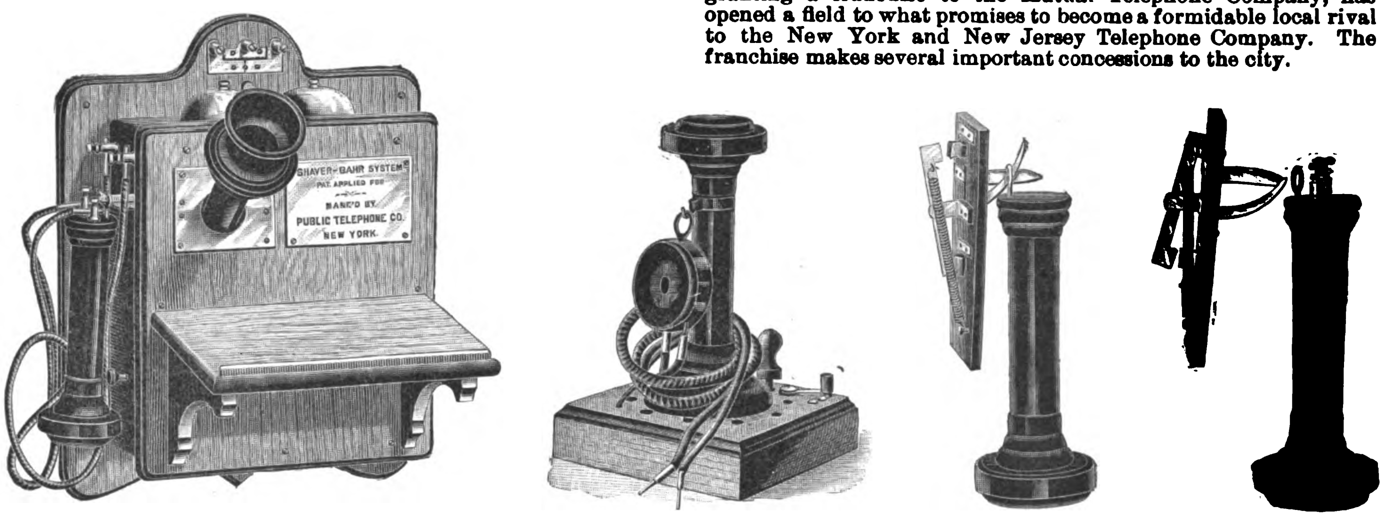
TELEPHONE LINES AS COMMON CARRIERS.

A bill has been introduced in the Indiana Legislature which compels each telephone company to permit the use of its exchange toll line or toll station to any other company owning or operating a telephone system, and at fair rates. The Bell telephone toll lines have been closed against messages from competing systems, hence this proposed legislation.

THE PUBLIC TELEPHONE CO.'S INSTRUMENTS.

WE illustrate in the accompanying engravings the new instruments of the Public Telephone Co., of this city. In these the magneto principle is employed both in receiver and transmitter. Fig. 1 shows the wall set and Fig. 2 the desk set. In the latter the bottom of the magnet is extended into the flared cast iron foot which rests on the wooden base.

A very novel method of switching is employed in place of the familiar spring actuated hook. This is shown in the engravings Figs. 3 and 4. The former shows the receiver suspended on a stationary horizontal tongue and merely held in position by a curved lever, at right angles to which is pivoted a bar to the ends of which the contact points are fixed. In the position shown in Fig. 3 the magneto is in circuit. When the receiver is withdrawn, as shown in Fig. 4, the curved lever is forced downward, and throws the contact over to the transmitter point. In both instances the contact carrying bar is thrown over its centre point by the spring. The articulation of the instrument is exceedingly clear.



FIGS. 1, 2, 3 AND 4.—THE PUBLIC TELEPHONE CO.'S INSTRUMENTS.

TELEPHONE NOTES.

JEFFERSON CITY, MO.—In the senate a bill has been introduced fixing the annual rental of telephones at from $30 to $60 a year.

RICHMOND, IND.—The city council has given the Harrison Company a telephone franchise.

THE RAWSON ELECTRIC CO. has been formed at Elyria, O., with a capital stock of $50,000, for the manufacture of telephones.

LUMBERTON, MISS.—A company has been organized to construct a telephone line to McComb City.

ELWOOD, IND.—The Magneto Telephone Company has contracted to put in an exchange of fifty telephones at Frankton, and to build a toll line connecting that city with Elwood.

BOLIVAR, MO.—A telephone company has been organized for the purpose of constructing a telephone line between Springfield and Bolivar and connecting with intermediate points.

FLINT, MICH.—The Flint Electrical Company has applied to the Lapeer council for a franchise to put in a telephone exchange there.

WESTFIELD, MASS.—After February 1, telephone news will be given a reduction from the present rate of $3 per year, making the tariff for office service $39 and for residences $33.

ROANOKE, VA.—A charter has been granted to the Roanoke Telephone Company, the object of which is to establish a new and cheaper system than the present one used. The charter recites that the capital stock shall not be more than $35,000 nor less than $10,000, divided into shares of the par value of $100 each. The officers of the company are: President, Ballard P. Huff; vice-president, W. E. Deaton; secretary and treasurer, W. K. K. Andrews.

SHELBYVILLE, IND.—Representatives of the Phoenix National Telephone Company, of Indianapolis, have closed the contract with the Mutual Telephone Company of this city to place two hundred telephones in the city at once.

SIOUX CITY, IA.—A movement is on to organize a big telephone exchange in Northwest Iowa, to include all the counties on the western border of the state as far south as Woodbury, by which all the larger towns will be given connections with one another.

GRAND RAPIDS, MICH.—The Telephone Company's ordinance, giving it the right to place wires underground under the direction of the Board of Public Works, was placed on its second reading and ordered printed.

SHEBOYGAN, WIS.—At the last common council meeting William Meter asked for a telephone franchise. Mr. Meter sells the instrument at $30 to the users, charges them at the rate of $1.50 per month for service and promises them a metallic circuit.

PEEKSKILL, N. Y.—The Century Telephone Company has applied to the corporation authorities for permission to erect poles in the village. They are to give this place a new telephone service in connection with one which they are organizing throughout the county.

ELIZABETH, N. J.—The Elizabeth city council, by its action in granting a franchise to the Mutual Telephone Company, has opened a field to what promises to become a formidable local rival to the New York and New Jersey Telephone Company. The franchise makes several important concessions to the city.

THE METROPOLITAN "L" ROAD at Chicago, now have enough cars on hand to make several trains, an additional number having arrived some time ago. As far as the rolling stock is concerned, it appears that the road will soon be able to start, although the officials are not yet prepared to give the exact date.

THE AMERICAN BUREAU OF ELECTRICAL ENGINEERING, INFORMATION AND EMPLOYMENT, is the somewhat brief name of a company just incorporated at Chicago with a capital stock of $1,000,000. The name is indicative of the object of the company. The incorporators are Clinton E. Woods, Francis E. Drake and P. Malden.

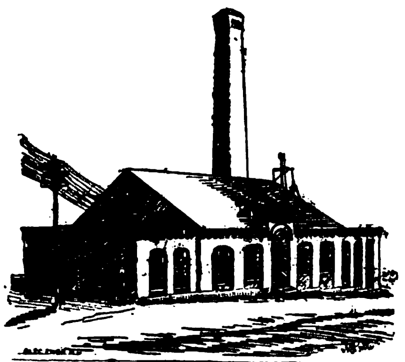
FORT WAYNE, IND.—The Harrison Telephone Company and the Ft. Wayne District Telegraph Company have consolidated their interests, and will unite all subscribers, franchises and systems, to fight the Central Union Telephone Company, originally the old Bell Telephone Company. Telephones are to be put in for $1.50 a month.

THE NORTHWESTERN "L" ROAD at Chicago is slowly getting in shape to commence construction. The first condemnation suit came to trial on the 23d inst. The property in question is on the main line of the proposed road and involves some fifteen pieces of property, including a strip through the tract owned by the McCormick Theological Seminary.

WAUSHARA, WIS.—At the annual meeting of the Waushara Telephone Company of Waushara county the following officers were elected: John Moffat, president; Mahlon Safford, vice-president; Matthew Whitney, secretary; L. E. Davis, treasurer; directors, M. Safford, J. J. Wood, Jr., Berlin; James Spencer, Auroraville; John Moffatt, Poysippi; Charles Kimball, Pine River; John P. Pederson, Mt. Morris; George P. Walker, Wautoma.

MISCELLANEOUS.

THE MARBLEHEAD MUNICIPAL PLANT.



Municipal Electric Lighting Station, Marblehead, Mass.

The town of Marblehead, Mass., after groping in the dark for many years with the assistance of a few scattering gas and oil lamps placed at more or less infrequent intervals about the streets, decided last March to build an electric plant of its own at an expense of $60,000. The committee in charge went to work with a will, erected a substantial building, contracted with the Western Electric Company for the electrical equipment, and on Jan. 28, turned on the current. The plant is said to be second to none in the state in point of completeness and excellence of design. The building is of brick with granite trimmings one story high with an iron monitor roof. The engine and dynamo room is 63 feet long by 52 wide.

There are two 100 H. P. engines built by the Rice & Sargent Engine Co. of Providence, R. I. One is cross-compound condensing, 14x26x36, and the other a high pressure engine, 14x36. They are of the four-valve, releasing gear type, with double ported Corliss valves. They are finely finished and fitted with all the latest appliances for the economical use of steam. Each has a fly-wheel 12 feet in diameter which weighs 20,000 pounds and carries a 30-inch belt connected with the line of shafting across the room carrying pulleys which are belted to the dynamos. The main belt from one engine is thus attached to the shafting at one end, the belt from the other connecting at the other extreme. The shafting is provided with friction clutches, by means of which power can be taken from either engine, or by which both may be worked together, the adjustment being so fine that each must do its proportionate part of the work. By disconnecting the shafting at the middle each engine can operate half of the line independent of the other. Ordinarily one engine will do the work alone, the other being in reserve in case of accident. These engines are the first of the kind that have been built by the Rice & Sargent Company which is a comparatively new concern, and nothing has been spared in them which would make them all they should be. Besides these a single cylinder engine is held in reserve.

There are four Western Electric arc dynamos of 50 lamps capacity each and a 1,000 light Westinghouse alternating incandescent machine. In the boiler room are two steel boilers of 250 horse-power each, built by the Atlantic Works, a Knowles condenser and steam pump, and a Wainwright heater. The boiler is supplied with a smoke consumer. The circuits are eight in number, six arc and one incandescent for street lighting and one incandescent for commercial lights, containing in all 31 miles of wire.

In the distribution of the lights the town takes 165 arcs of 2,000 c. p. and forty 25 c. p. incandescents. The plant is operated under the direction of a committee, and the street lights are run on a moonlight schedule. The committee at present consists of Messrs. W. J. Goldthwaite, J. B. Litchman, B. J. Lindsay and H. C. Sparhawk; and the engineer in charge of the construction was Mr. Charles T. Main. The people of the town are enthusiastic over the success of the enterprise.

ELECTRIC LIGHTING FOR CARRIAGES.

In a recent report to the State Department C. W. Chancellor, the United States Consul at Havre, France, makes some pertinent remarks concerning the lighting of carriages by electricity. He says:

"Gas lighting, which was common in London as early as 1810, was not introduced into Paris until 1819, and more than twenty years elapsed before its use as an illuminant became general in France. On the other hand, when we turn to the subject of electric lighting, it must be admitted that France has taken a foremost rank among European nations in adopting the electric light.

"In Paris, electrically lit private carriages have, for the last five years, been extensively patronized by the affluent classes, but only recently has this process of lighting been applied to private carriages in London and Berlin. The Prince of Wales was the first to adopt it in London, and now we learn that the German Emperor has brought the resources of his active mind to bear on the subject of lighting carriages, and, as a consequence, the court carriages in Berlin are now lit by electricity, not only by outside lanterns, but also in the interior, which is illuminated by a series of accumulators carried in the vehicles. All over the harness are placed what the Germans call Glühlampen, or small, colored lights, which glow like fireflies when the carriage is in motion."

It is obvious that the adoption, on an extended scale, of electricity as an illuminating agent in private and public vehicles would serve a double purpose—first, one of a distinctly practical usefulness; next, that of increasing the brightness and cheerfulness of the streets, which would materially aid in the beautifying of a city. Again, it has been ascertained that the more the omnibus and street car companies make their vehicles attractive, the greater will be their traffic.

In private carriages, the electric lamp is placed inside, in the centre of the roof, and the flat twin lamps are shielded by a circular glass plate rather larger than the "bull's-eye" of an ordinary searchlight. At the back of the lamp, there is a dome or bell-shaped enameled reflector. In order to economize space, the flat lamps are not hung vertically in the bell protector, but lie horizontally, and in order to prevent the filament from drooping when hot, a little glass anchor is added to support them. In this way, the roof of a brougham is fitted with a light diffuser which will not interfere with a person's head entering the vehicle. Each of these lamps gives a light equal to seven candles.

In the first attempt to light carriages in this manner the moving of the carriage was apt to jar the lamps, often causing a breakdown, and steel springs were not found sufficient to prevent this. The plan now adopted is to suspend the complete lamp in a sheet of rubber, which is attached to the interior of the carriage, neutralizing the vibration. It is only necessary to press a button in order to switch the current on, and by a second push it is turned off again.

A sufficient supply of electricity required for the lamp is stored in an accumulator. One accumulator, weighing two pounds, is the allowance for each lamp. Should the two outside lamps be also electric, two additional batteries would be needed. The accumulators are carried in the boot, under the coachman's seat, and are easily accessible. The coachman himself, without electrical knowledge, makes the necessary connections.

An eight-cell storage battery for an ordinary familly carriage or brougham is contained in a box 8 inches long, 4 inches wide, and 7 inches deep. This supplies the current to keep the lamp lighted for eighteen hours, which, ordinarily, is sufficient to last the owner of the carriage from one to two months. The cost of recharging varies from 50 cents to $1—not more than the expense entailed by the employment of oil lamps, which invariably give out an unpleasant odor and an uncertain illumination. The electric lamp does not wear out unless subjected to careless treatment, or unless it is weakened by the application of too strong a current. The accumulator, however, makes the latter contingency almost an impossibility.

There appears to be a fair prospect that, in the course of a few years, the majority of public conveyances in cities, as well as private vehicles, will be lighted by electricity; but the public will, of course, expect that electric lighting shall be superior to oil. This question seems to have been already quite well determined. It has been found that an electric lamp of 2½ candle power will enable any passenger to read in comfort while traveling. Apart from the actual amount of light to be afforded, which, of course, is capable of adjustment, it may be stated that the latest form of battery overcomes the difficulties which have hitherto stood in the way of the adoption of electricity for the lighting of street conveyances.

A street-car battery, working two lights to illuminate the interior as well as the colored signal lamps, will weigh about 30 pounds, and furnish a light, equal to 2½ candle power, for from forty-five to fifty hours.

Lamps applied to omnibuses, street-cars, and cabs differ in form. The omnibus light is fixed in a globe, smaller and flatter than the pattern which screws the oil lamps in a European railway carriage. Behind the lamp is a concave reflector of enameled iron. There is no restriction as to the form of the street car lamp, as the same conditions do not apply; but in the cab lamp, where economy of space is a consideration, the globe, contained in a semi-circular reflector, having a glass front, is placed upright at the back of the vehicle, over the passengers' heads. The cost of such installation, including the accumulator, is about $50.

A PROGRESSIVE STEAM RAILROAD.

Mr. John M. Moffatt, E. E., electrician of the Erie & Wyoming Valley RailroadCo. writes us:—"We have installed a 500 light arc and 600 light incandescent plant; built 50 miles of copper metallic circuit for our telephone lines and equipped 60 offices with long distance service; put in the Hall signals at grade and highway crossings; and applied electricity in various ways in the mines and workshops of the Company. In fact, we are endeavoring to keep up to date, and find THE ELECTRICAL ENGINEER an indispensable aid."

TRAINED WIREMEN ONLY FOR HARTFORD.

The fire-underwriters of Hartford, on account of many fires arising from electric wires, have voted to petition the City Common Council to prohibit any one except a trained electrical workman from wiring buildings.

TYPICAL 19TH CENTURY "LEGISLATION."

The present New York Legislature is giving evidence of the presence among its members of gentlemen with what some people might call predatory instincts. In the Senate, Mr. Owens has introduced a bill providing that in New York and Brooklyn the price of incandescent lights shall not exceed one half cent per hour per light and that for arcs shall not exceed 4 cents per hour. In the Assembly, Mr. Wieman has a bill to fix day telegraph rates at one cent per word and night rates at a half cent. "Legislation" of this character is sometimes called socialistic. It is perhaps in the nature of a "strike."

GETTING THE "CONSOLIDATED" READY FOR ELECTRICITY.

A special dispatch from Boston of Jan. 30, says:—

President Clark of the Consolidated Board came up from New Haven yesterday afternoon, and, with officials of the Old Colony Division, went to Nantasket for the purpose of looking over the route of the proposed electric line from Hingham to Hull. After inspection, it was unanimously conceded that the conditions were in every way favorable to trying the experiment, and upon the success of this tentative trial will largely depend similar action on other branch lines of the corporation. President Clark said to-day: "We are going to demonstrate whether electricity is a plaything in its relation to transportation or something that is practicable and is with us to stay. We propose placing the motors on our ordinary steam cars, the first trial of the kind, I believe, that has ever been attempted in this country. The results we shall obtain will largely govern our future policy in relation to other branch lines under our control."

CONTEMPLATED SALE OF THE MARIETTA, O., MUNICIPAL LIGHTING PLANT.

The city council of Marietta, O., has in contemplation the sale of the city's electric lighting plant. This step has been induced by the desire of the citizens to obtain an electric street railway in place of the horse car line now operated in the town. The city, of 10,000 inhabitants, has 105 arc lamps. The horse car company proposing to build the electric road claim that they cannot go to the expense of making the change to electricity unless they obtain the entire electrical service of the city. As the city is anxious to have electric cars it is willing to sell its plant, providing it does not have to pay a company more than it can do the work for itself; and a committee of councils with Mr. S. J. Hathaway, secretary, is now seeking for information which will guide it in fixing the charges which the new company is to make for public lighting and for private as well. The new company propose to utilize a water power 5 miles distant.

ROBERTS' SLIDE RULE WIRING CALCULATOR.

We have received from Mr. J. Wilson Brown, of Palmer, Mass., the agent for the Correspondence School of Technology, Cleveland, O., the Roberts' Slide Rule Wiring Calculator. This handy little scale is based on the law of the B. & S. gauge, and this fact enables a universal scale to be made without complication. The scale ranges from No. 20 up to 500,000 circular mils. By its aid the following problems can be solved off hand. Given, the ampere feet and volts loss; to determine size of wire. Given, the ampere feet and size wire; to find the drop. To find the area of cross-section and the equivalent size of a number of small wires.

The scale was devised by Mr. E. P. Roberts, and is published by the Correspondence School of Technology, Cleveland. It is gotten up in neat vest pocket from enclosed in a leather case; price, 50 cents.

THE BREAKING OF ANOTHER BIG FLYWHEEL.

While going at a terrific speed a flywheel, 20 feet in diameter, broke in 1,000 pieces at the Edgar Thomson Steel Works recently, says the *Pittsburgh Dispatch*, and made a wreck which cost $20,000. The engine to which the wheel was attached was one of the largest and best ever constructed for blast-furnace purposes. It was built after a special design at a cost of over $10,000 and was considered a model piece of machinery. A large ball connected with the governor became detached in some way and flew off. This permitted the engine to "run away," as engineers say, and with nothing to regulate the pressure of steam the big wheel was sent spinning. The speed kept increasing, and it became evident to the engineer that the wheel could not hold together. He attempted to stop the engine, but failed, and soon the wheel with a terrific crash went to pieces, threshing the big engine into a thousand fragments and hurling tons of iron through the walls of the building like cannon-balls. The entire end of the building and part of the roof was demolished.

THIRD EDITION OF "THE INVENTIONS, RESEARCHES AND WRITINGS OF NIKOLA TESLA."

"The Inventions, Researches and Writings of Nikola Tesla," by Thomas Commerford Martin, published by The Electrical Engineer, N. Y., has met with remarkable success. The first edition appeared during January, 1894, and the second was completely exhausted before the close of the year, several orders now being in hand for the third, which is expected this month. It is rarely that technical books have such a reception. The welcome accorded to the work abroad has also been most cordial. It has been favorably reviewed by the technical press of England, Germany, France, Russia, Italy and other countries; and an authorized German translation is now being brought out by the well known house of W. Knapp, of Halle. The book embraces all Mr. Tesla's inventions and researches made known up to date, and includes his oscillator, or new electrical generator, which he is rapidly bringing to a high pitch of efficiency and economy. The more important parts of the book have had the benefit of Mr. Tesla's personal revision.

ON THE SPECTRUM OF THE ELECTRIC DISCHARGE IN LIQUID OXYGEN, AIR AND NITROGEN.

In the *Philosophical Magazine* Profs. Liveing and Dewar describe a series of experiments in which sparks were passed through small layers of the liquified gases, one or both electrodes being immersed. When both electrodes were immersed there was a continuous spectrum, probably due to the heated particles which left the surface of the electrodes, and also a line and band spectrum due to the liquid itself. The lines were faint and few unless a Leyden jar was put in the circuit. These lines could nearly all be identified with the known lines of the gases. When one electrode was out of the liquid, more bands appeared, and various interesting changes took place. The most noteworthy observation made was that when sparks were passed through oxygen liquid and vapor, one electrode only being immersed, a band appeared between λ 5530 and λ 5610; and if a Leyden jar was put in the circuit, this band contracted to a line at about λ 5572. The wave-length of the Aurora line is λ 5571.6; and the condition of temperature and pressure in these experiments must have been somewhat similar to those under which the Aurora appears. This points to the probability of the Aurora line being due to the oxygen of our atmosphere.

AN OFFICIAL TELEGRAPHIC VOCABULARY.

The International telegraph office at Berne has just published a new vocabulary of ciphers for telegrams in preconcerted language, prepared by linguists and expert telegraph operators, in accordance with the decisions of the International Telegraph Conference of Paris. The volume contains 256,740 words, all in alphabetical order—no word containing less than five letters nor more than ten, and all being selected upon the principle of a dissimilarity of at least two letters and of three elementary Morse signs. The words are all numbered, starting from 000,000. The three figures representing the thousands are given at the head of each page, and the three figures representing the hundreds, tens, and units before each word. The object sought to be attained by the issuance of this vocabulary is to facilitate the transmission of messages over the wires and to prevent the use of words not found in dictionaries and of arbitrary groups of letters in form of words.

The bureau states that the employment of the official vocabulary will become obligatory in the European system after the expiration of three years from the date of its publication. For telegrams under the extra European system, its employment will be optional for the present.

TO MINE COAL IN OHIO BY ELECTRICITY.

Despatches from Massillon to the *Cleveland Plain Dealer* state that operators are considering the fitting of their mines with electric mining machinery, which will displace all men except common laborers to load the coal and men to work the machines. There is not much doubt but that in a few years hand mining will be done away with in all expect very thin-vein mines, where machinery constructed as at present could not be used to advantage.

More than one operator has obtained figures on electric plants,

but it is not the operators who are the progressive ones. In this instance the electrical manufacturers are the ones who see the good thing and want to push it along. A coal man said that operators who have thick-vein mines have received propositions from the manufacturers offering to put in the machinery and take their pay in the shape of the saving between hand and electrically mined coal, which is variously estimated at from 10 to 30 per cent. A very few mines are fitted with electrical machinery, but there is a story about to the effect that a new mine to be opened at Salineville is to have a plant to cost from $20,000 to $25,000.

AN ELECTRODE SENSITIVE TO LIGHT.

In the *Zeitschrift fuer Physikalische Chemie*, H. Luggin describes a new form of electrode which he claims to be much more sensitive to light that any that has hitherto been made use of in previous investigations. Briefly, its essential features are as follows: A plate of platinum is coated with silver bromide and is then duplicated with a similarly coated platinum plate in an aqueous solution of bromide of potassium. A quadrant electrometer of the usual type is employed in observing the rise of potential. Luggin states that in some of his experiments exposure to diffuse daylight was sufficient to cause a rise of potential of 0.5 volt, thus demonstrating the great usefulness of this new form of electrode. When illuminated by any weak light it appears that this elecrode shows a rise of potential which is uniform, and can be represented graphically in a system of coördinates by means of a straight line until a maximum is reached, after which it remains constant or may show a slight fall. The rate of increase of potential is much more marked when a stronger light is employed, but for all that the maximum value attained is not higher. The rate of rise, however, is not directly proportional to the intensity of the impinging light, whilst it is also lowered by a previous exposure of the electrode to a powerful light. Continuous and intermittent lights of the same intensity do not appear to produce the same effect on the potential. These plates, though ingenious and likely to become exceedingly useful in certain investigations do not remain constant as regards their sensitiveness, and even after long rests they show with the same sources of light very different increases of potential.

SPECIAL ARRANGEMENTS FOR THE CLEVELAND CONVENTION.

Arrangements have been completed, by Mr. C. O. Baker, Jr., Master of Transportation, with the New York Central & Hudson River R. R. Co., for a special train of Wagner vestibule, parlor, dining room and buffet cars, leaving Grand Central Depot, 42nd street, N. Y., at 9.30 A. M. Monday, February 18, running as second section of the Fast Mail on the following schedule:—Leaving New York 9.30 A. M., Albany 1 P. M., Utica 3.17 P. M., Syracuse 4.40 P. M., Rochester 6.30 P. M., Buffalo 7.25 P. M. (Central Time), Erie 9.33 P. M. (Central time), arriving at Cleveland 11.55 P. M. (Central time). Seats can now be secured on this train by applying in person or by letter to the office of the National Electric Light Association.

A special rate has been granted (on certificate plan) of a fare and one third from all points in the United States East of the Mississippi River, Peoria and Chicago, Ill., to Cleveland. To obtain this rate it is necessary in purchasing going ticket to ask the ticket agent for a certificate, which, when properly viséd and endorsed at Cleveland will entitle the purchaser to a one third fare returning.

That the best results may be obtained, it is very desirable that delegates should make their application for space on New York Special at the earliest possible moment. The following gentlemen have charge of transportation in their respective districts, and to them application can be made for all information.

A. C. Shaw, 620 Atlantic Ave. Boston, Mass.; H. A. Cleverly, 1018 Chestnut St., Philadelphia, Pa.; E. H. Heinrichs, Westinghouse Electric Co., Pittsburg, Pa.; E. L. Powers, Monadnock Building, Chicago, Ill.

In addition to the papers and topics heretofore furnished for the Cleveland programme, there will be a paper entitled "A New Method of Measuring Illumination" by Professors E. J. Houston and A. E. Kennelly. Topic: Underwriters Rules vs. National Electric Light Association Rules. Topic: Practical demonstration of protecting lines from lightning: A. J. Wurts.

A LIGHTING VOLTAGE.

A SPECIAL despatch to the Manchester, (N. H.) *Union* is as follows: LANCASTER, Jan. 10.—Another dynamo is to be added to the electric light plant. It is to be of the latest improved specimen and will have a capacity of 14,000,000 volts per second. It has been constructed especially for volts, instead of the common kind of electricity.

PERSONAL.

AUGUSTUS NOLL.

Augustus Noll.

THE fact that Mr. Augustus Noll has recently resigned his position as electrical engineer and general superintendent of the New York Electrical Equipment Co. and established himself as a member of the contracting firm of Noll & MacLean, is one of interest to those who have witnessed his steady professional advance. Mr. Noll is a New Yorker and a graduate of the city's excellent public schools. He was born in 1860, and therefore is one of the younger members of the profession. After leaving school, he took up mathematics and electrical and mechanical engineering as a special study, but grappled also with practical work by spending a couple of years in a shop working on bells, burglar alarms, etc. He also gave public exhibitions of one of the first Edison phonographs. In 1880, he became connected with the old Edison Electric Light Co. in its installation department, in this city and with the meter department of the pioneer First District station. He was also engaged on experimental work in the Edison Machine Works, and then went to various parts of the country to install isolated Edison lighting plants. In 1885 he took up contracting work on his own account, and had a great deal to do in the renovation of several important plants that had been put up when the conditions to be met were not understood. Among these may be mentioned the plant on the transatlantic liner "Oregon," and that of the first three wire "village station" at Sunbury, Pa. Under the supervision of Mr. Luther Stieringer, he was also employed on the important Edison installation at the Louisville Exposition, the first large three wire plant anywhere.

From first to last, Mr. Noll has perhaps been instrumental in wiring more buildings of any size than any other man in America, and he has a corresponding fund of data and experience. His work can be found in most of the theatres in New York, as well as in a great many of the newer hotels; and he has lately had charge of the electrical equipment of such large edifices as the Metropolitan Opera House, and Abbey's Theatre. This, of course, is wholly with continuous current, but he has worked also in the other branches, installing for example upwards of 20,000 lights on the alternating system for the Manhattan Electric Light Co., with transformers connected in multiple, and on the 2-wire and 3-wire systems. All told, Mr. Noll has wired either as contractor or under his personal supervision, over 300,000 incandescent lights, to say nothing of much power work and arc lighting.

After a brief and interesting experience as a manufacturer, Mr. Noll reverted to his original work, and in 1892 acted as advisory electrical engineer to the New York Insulated Wire Co. and Mr. George Westinghouse, Jr., on the contract for wiring at the World's Fair. He, declined, however, to take any charge of the work at Chicago, and associated himself with the New York Electrical Equipment Co., for practically all of whose work he acted as general superintendent until recently.

From time to time, Mr. Noll has contributed to these columns on wiring, and he has taken out various patents on wiring, conduits and apparatus. In 1886, his views and practice in wiring were presented to the National Electric Light Association at Detroit, and he has read papers at the later conventions in Providence and Montreal. About a year ago he published a book entitled "How to Wire Buildings," which has already run through three editions and continues in active demand, both here and in Europe. It has proved an invaluable contribution to the electrical literature of practical work. Mr. Noll has always shown himself willing and anxious to disseminate for the benefit of those working in the same field the results of his ripe experience and wide reading. He has deep convictions on the vital importance of good wiring to the prosperity of electric light and power and does what he can to enforce his beliefs by example and precept. He is a full member of the American Institute of Electrical Engineers.

In his new venture, Mr. Noll has associated with himself, Mr. Howard A. MacLean who has had nearly 15 years' experience on the commercial side of the Edison business; and they have already closed several large wiring contracts. They propose to

do contracting work only, employing the best labor methods and material. Known as they are to every electrical engineer and architect in this vicinity, there is no doubt that along such well defined lines they will find themselves abundantly busy and prosperous.

LEGAL NOTES.

DECISION IN FAVOR OF "VULCA" DUCTS SUSTAINED.

The U. S. Circuit Court of Appeals in this city has confirmed the decision given some time since by Judge Coxe, refusing to the Interior Conduit and Insulation Co. an injunction, on certain patents, against the Eureka Electric Construction Co., which had installed "Vulca" ducts in buildings in New York City. While the Eureka Co. were sued, the case was fought and won by the New York Insulated Wire Co., the manufacturers of the "Vulca" ducts for interior wiring. It will be remembered that Judge Coxe held that the patent sued under had not disclosed any new idea to the art, and that the claims were not sustainable on grounds of novelty and merit.

NEW HAMPSHIRE STEAM-ELECTRIC RAILWAY LEGISLATION.

An important bill known as the General Electric Railroad measure has been introduced in the New Hampshire Legislature. It is mainly taken up with regulation of street railway work and franchises and the prohibition of crossings at grade; but there are two paragraphs as follows, permitting a change to be made to electricity as a motive power by steam railroads:—

Sec. 30. All railroad corporations established under the laws of this state, and operating railroads therein with steam for a motive power, are hereby authorized to operate their railroads by electricity, and for the purpose of making the necessary changes from steam to electricity as motive power, every such railroad corporation, may, with the consent of the railroad commissioners, and subject to the provisions of sections of this act, issue such an additional amount of capital stock as may be necessary to defray the expenses of making such change in motive power.

Sec. 31. If any existing steam railroad shall build extensions, branches or additions to its lines to be operated by electricity as the motive power, such steam railroad shall have the same right to build and operate such extensions, branches and additions in the public highways, and be subject to all the duties, liabilities and restrictions as to that part of said extensions, branches and additions operated by electricity in public highways, as by the provisions of this act are conferred and imposed upon street railways in their use of public highways.

Mayors and corporations are given control of local construction and a violation of regulations has a fine of $300 attached to it.

LITERATURE.

American Electric Street Railways. By Killingworth Hedges. New York, Spon & Chamberlain: 1894. 205 pp. 8 x 11 inches. Profusely Illustrated. Cloth. Price, $5.

ONE would hardly expect to go abroad for a work on American electric railways, in view of the wealth of literature already extant on the subject published in this country, but the work before us is one that takes a distinctive place in the literature of the art, in that it may be said to treat the subject in a manner somewhat different from that which we have thus far been accustomed to. It has been the aim of the author to describe our methods of railway building and operation, and for that purpose he has availed himself of numerous sources which, it must be confessed, he has employed with judgment and discrimination. Beginning with a few general historical notes and an elementary description of the general principles involved, we are passed to the chapters devoted to construction of the permanent roadway and overhead conductors, conduit systems, and the cars and other electrical equipment, the latter including not only the general description of motors, but also of trucks, brakes, fenders, diagrams of electrical connections and wiring, controlling devices, methods of lighting and heating, snow plows, etc. Special chapters are devo ed to electric motors and electric generators, in which the latest machines are described and illustrated. The diagrams of the series parallel controllers will prove very helpful to those desiring to study out this method which has created little short of a revolution in electric railway work. We also notice a very instructive series of curves, showing the variation of current as between the series parallel and the rheostatic method of control, proving the immense superiority of the former as an economizer of current.

Under the head of "Engines and Boilers," we find descriptions of some of the latest station equipments in this regard and the interesting table, showing the cost of steam plants necessary to generate and distribute current on a 500 volt circuit, with various types of engines from the data of Dr. Emery, and Messrs. Crosby and Bell. The author states that the English electrical engineer would be surprised and, perhaps, disappointed to find in the majority of the older power stations the old fashioned belt driving arrangement still in vogue, instead of the direct coupled engines and generators which are the rule abroad. But the number of large power houses recently equipped with direct connected engines is sufficient proof of the fact that we have recognized their true value and that the older stations represent the stage of evolution in American electric railway practice, from which we have indeed learned much and, without the lessons taught by which, we would not be advanced to our present stage of development. Indeed, the work itself, illustrates not a few of such direct connected units. Under the examples of electric railways, we note a succinct description of the Niagara Falls, Park & River Railway, derived from that which appeared in THE ELECTRICAL ENGINEER, August 9, 1893, the thorough construction of which evidently appealed to the author.

Under the head of "Comparative Cost of Traction by Cable, Electricity and Animal Power," we find a collection of data, which brings out strongly the superiority of electric traction as a method calculated to earn the highest dividends in all but very exceptional cases. The author has also embodied a short chapter on English electric tramways, in order to base a comparison between the cost of operation there and in this country. He shows, among other things, the favorable position occupied by our railways as dividend earners, owing to the small amount paid to the cities as taxes. The Bessbrook & Newry Tramway, $3\frac{1}{10}$ miles long, one of the first roads established in Ireland, exhibits a cost of operation per train mile of 3.94 d., while the Roundhay Electric Tramway at Leeds shows an operating cost per car mile of 5.557 d. The South Staffordshire Electric Tramway, 8 miles long, figures at 4.06 d. These figures, it must be admitted, are lower than are generally obtained among American electric railways, but, taking into consideration the disparity in the cost of labor, attendance and fuel existing between the two countries, it would appear that our own electric railways are operated at about equal economy with those in England.

It would lead too far to enumerate all the interesting and valuable data which Mr. Hedges has embodied in this work, but it suffices to say that it gives the best present insight into American electric railroad work, especially in a practical way, and hence is of special value, not only to those directly interested in the operation of such roads, but to those who desire to obtain an intelligent idea of a subject which is more and more absorbing public attention. The large form in which the book is got up gives excellent opportunity for the display of the large and clear illustrations with which the book abounds, and which add greatly to its value.

Konstruktionen für den Praktischen Elektrotechniker. By Wilhelm Biscan. Part I. Oskar Leiner. Leipsic, 1894. Price, 60 cents per part. 9 x 12. Six plates with explanatory text.

IN this publication the author gives the drawings to scale of a variety of electrical apparatus, each accompanied by explanatory text. The part before us contains descriptions of the dynamo built by Kremenezsy, Mayer & Company, of Vienna, a horizontal pocket galvanometer, and a differential arc lamp with ring magnet for alternating currents, built by Ganz & Co., of Budapest. All the apparatus described in this series is in actual use, so that the information derived is, in the highest degree, practical.

STANDARD UNDERGROUND CABLE CO.

On January 26th, 1895, the Board of Directors of the Standard Underground Cable Company, held their first regular meeting after the annual stockholder's meeting of January 22nd, and elected the following executive officers of the Company for the ensuing year:—George Westinghouse, Jr., president; Joseph W. Marsh, vice president and general manager; Frank A. Rinehart, secretary and treasurer; Charles M. Hagen, auditor. At the annual meeting of the stockholders, Joseph W. Marsh was also re-elected as one of the directors of the Company. Mr. Marsh is now entering upon the fourteenth year of his connection with this successful corporation, during most of which time he has been its general manager.

ANNUAL MEETING OF THE BERLIN IRON BRIDGE CO.

The annual meeting of the stock-holders of the Berlin Iron Bridge Co. was held at the office of the company, at East Berlin, Conn., on Tuesday, Jan. 29. The following Board of Directors was elected:—Chas. M. Jarvis, Geo. H. Sage, F. L. Wilcox, and Burr K. Field, of Berlin, Conn., S. Howard Wilcox, of Brooklyn, N. Y., Julius Burr, of East Berlin, Conn. and H. Peck, of Waterbury, Conn. By vote of the stock-holders, the capital stock of the company was increased from $300,000.00 to $500,000.00. The new issue of stock has all been taken by the old stock-holders.

MR. JOSEPH SACHS is representing various concerns at the Cleveland Electric Light Convention, including D. Van Nostrand Co., Solar Arc Lamp Co., Rossiter & McGovern and others. He is open to make further arrangements. His address is 32 Nassau St.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JAN. 29, 1895.

Alarms and Signals :—

Circuit Closer for Railway Rails, E. C. Wiley, Bristol, Tenn., 533,154. Filed May 29, 1894.

A friction drag-slide carrying the contacts is operated by the bending of the rail.

Automatic Electric Signal, H. C. Storrs, Hartford, Conn., 533,183. Filed April 20, 1894.

A holdback device which is liberated by the melting of a fusible material.

Gauge Alarm, W. A. Stafford, Meadville, Pa., 533,241. Filed April 17, 1894.

Signaling Telegraph, F. A. Turner, Chelsea, Mass., 533,254. Filed July 27, 1893.

A police telegraph signal system which indicates at the central station the number of the box and the officer sending the signal, or other special signals such as for an ambulance, patrol wagon, etc.

Automatic Electric Safety System for Railroads, R. R. Snowden, & A. C. Ives, Ocala, Florida, 533,398. Filed Jan. 26, 1894.

A system in which the steam valve of the locomotive is automatically closed and the air brake supplied when the track conditions are not normal

Distribution:—

System of Distribution by Alternating Currents, C. P. Steinmetz, Schenectady, N. Y. 533,244. Filed April 2, 1894.

Claim 1:

The method of maintaining polyphase electromotive forces in the different mains or branches of a polyphase distribution system, which consists in connecting electrically or inductively two or more of such mains to the terminals of a main source of electromotive force of the single-phase type, and similarly connecting another of the main to such source through a supplementary source of electromotive force of different phase relation, whereby such last mentioned source of electromotive force gives rise to a desired difference of phase between the mains.

System of Electrical Distribution, C. P. Steinmetz, Schenectady, N. Y., 533,245. Filed April 13, 1894.

Polyphase currents are generated at 60 degrees apart in phase and converted into three currents differing in phase by 120 degrees which are then employed to operate three phase apparatus.

System of Electrical Distribution, C. P. Steinmetz, Schenectady, N. Y., 533,247. Filed Sept. 24, 1894.

A modification of the "monocyclic system" of distribution described in THE ELECTRICAL ENGINEER, Sept. 26, 1894.

System of Electrical Distribution, C. P. Steinmetz, Schenectady, N. Y., 533,248. Filed Sept. 24, 1894.

The "monocyclic system" of distribution. See THE ELECTRICAL ENGINEER, Sept. 26, 1894.

System for and Method of Electrical Distribution of Energy, W. Stanley, Pittsfield, Mass., 533,328. Filed Nov. 3, 1894.

Claim 4:

The method of distributing electrical energy from several alternators which consists in running the alternators so as to generate currents of like phase, transforming the separate currents into currents of a different potential, and combining such transformed currents so as to produce in the working circuit a combined current of a potential like to that of the transformed currents.

System of Electrical Distribution, C. P. Steinmetz, Schenectady, N. Y., 533,378. Filed April 5, 1894.

The "monocyclic system," consisting in generating single phase currents in an electric circuit deriving therefrom an electromotive force of displaced phase, maintaining such electromotive force upon an additional main, and operating translating devices from such main and the mains of the single phase circuit. See THE ELECTRICAL ENGINEER, Sept. 26, 1894.

System of Electrical Distribution, C. P. Steinmetz, Schenectady, N. Y., 533 379. Filed April 11, 1894.

An arrangement whereby motors of the three phase type may be operated from line circuits in which flow currents sixty degrees apart in phase; this is effected by reversing one of the three coils of the motor so that the current flows through this reversed coil in an opposite direction, producing effects heretofore secured by currents differing in phase 120 degrees.

Dynamos and Motors :—

Rectifying Commutator and Method of Making Same, H. G. Reist, Schenectady, N. Y., 533,084. Filed Oct. 19, 1894.

A special construction of commutator for rectifying a part of the alternating current generated in alternators.

Electric Motor, C. Wirt, Chicago, Ill., 533,108. Filed Apl. 23, 1894.

Consists essentially of a pendulum or balance wheel whose movement is initiated and maintained by an electric actuated device.

Winding for Dynamo Electric Machines, C. P. Steinmetz, Schenectady, N. Y., 533,246. Filed July 14, 1894.

An arrangement for polyphase winding of railway motors consisting of two or more sets of coils each set overlapping within itself but not overlapping with other sets, so as to be easy of repair.

Monocyclic Motor, C. P. Steinmetz, Schenectady, N. Y., 533,249. Filed Nov. 20, 1894.

An induction motor having a closed circuit secondary member and a primary member wound with a main and teaser coil interlinked with one terminal of the teaser coil connected to an intermediate point in the main coil.

Monocyclic Motor, C. P. Steinmetz, Schenectady, N. Y., 533,250. Filed Nov. 24, 1894.

An alternating motor provided with main and teaser coils and a field winding energized from a source of direct current.

Conductors, Conduits, and Insulators :—

Combined Curb, Gutter, and Conduit for Electrical Conductors, W. Kingsley, St. Paul, Minn., 533,130. Filed Feb. 1, 1896.

Galvanic Batteries :—

Primary Battery, R. O'Toole, Mechanicstown, Md., 533,078. Filed Aug. 3, 1893.

A special construction of the copper oxide caustic potash battery. The copper oxide is contained within a receptacle made of iron wire gauze.

Lamps and Appurtenances :—

Electric Arc Lamp, H. O. Swoboda, New York, 533,100. Filed Mch. 2, 1894.

The lamp embodies a brake and brake wheel carried by a tilting frame, the brake wheel controlling the movement of the carbon.

Combined Portable Stand and Wall Bracket for Incandescent Electric Lamps, H. Horn, Philadelphia, Pa., 533,196. Filed Feb. 15, 1893.

The lamp support is adapted both as a portable stand and as a wall bracket or fixture.

Electric Arc Lamp, E. Conrady, Keighley, Eng., 533,211. Filed Dec. 16, 1893.

Claim 1:—

A feed mechanism for electric lamps comprising in its construction an elongated member coupled to the movable carbon through elastic connections and gripping devices to act on the elongated member.

Incandescent Electric Lamp, G. R. Lean, Cleveland, Ohio, 533,238. Filed Nov. 29, 1893.

Specially designed for the renewal of the burnt out filaments.

Measurement :—

Electrical Measuring Instrument, E. Weston, Newark, N. J., 533,107. Filed Mch. 11, 1891.

An instrument for measuring potential or current embodying a magnet with poles so arranged that there is an annular field between them and a coil supported so as to be bodily movable around and extending through the annular field.

Recording Ampere Meter, W. H. Bristol, Hoboken, N. J., 533,269. Filed July 26, 1894.

Similar in principle to the recording voltmeter of same inventor described in THE ELECTRICAL ENGINEER, Oct. 11, 1893.

Electrical Measuring Instrument, W. H. Bristol, Hoboken, N. J., 533,270. Filed Sept. 24, 1894.

Consists in a combination of a coil and a light disc armature, a swinging support for the armature and an indicating or recording device.

Miscellaneous :—

Apparatus for Stopping Engines, L. C. E. Meyer, Paris, France, 533,309. Filed Aug. 22, 1894.

A brake operating by the compression of a ball of india rubber in combination with a stop valve operated by an electric current.

Railways and Apparatus :—

Bonding Collar, N. M. Jacobs, New York, 533,221. Filed Sept. 12, 1894.

The bonding collar is provided with a coating of tin slotted longitudinally and threaded or roughened on the interior.

Electric Locomotive, S. L. Weigand, Philadelphia, Pa., 533,259. Filed Oct. 23, 1890.

An arrangement in which the axles are driven by worm and wheel gear.

Bonding Device for Electric Railways, J. J. Zimmele & A. Bournonville, Philadelphia, Pa., 533,261. Filed Nov. 30, 1894.

The ends of the bonds are slotted and expanded into the rail by a key.

Switches, Cut-Outs, etc. :—

System of and Apparatus for Controlling Electric Currents, W. B. Potter, Lynn, Mass., 533,083. Filed July 24, 1893.

An automatic circuit breaker arranged to operate all the circuit breakers upon the generation of an abnormal current on the line to which they are connected.

Controller or Switch for Electric Motors, W. J. Pohlman, Woodbrook, Md. 533,318. Filed Nov. 17, 1894.

Designed especially for controlling dental motors.

Telephones :—

Telephone System, J. I. Sabin & W. Hampton, San Francisco, Cal., 533,142. Filed Apl. 14, 1894.

A telephone system with bridged sub-station apparatus whereby the apparatus of several subscribers may be connected with a single line extending to the central station so that the operator may selectively signal either of the subscribers so connected.

Apparatus for Smoothing Currents of Dynamo Electric Machines, C. E. Scribner, Chicago, Ill., 533,146. Filed Jan. 16, 1892.

The method consists in shunting by a path of low resistance having electromotive force counter to that of the source of supply all excess of electromotive force due to the source of supply above the counter electromotive force of the path of low resistance. The counter electromotive force employed is a storage battery; the system is intended to operate transmitters in telephone stations.

Telephone Switchboard Apparatus, C. E. Scribner, Chicago, Ill., 533,147. Filed May 13, 1892.

By this construction the various keys of the connecting outfit are dispensed with.

Spring Jack for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 533,148. Filed May 23, 1891.

SOCIETY AND CLUB NOTES.

TEXAS STREET RAILWAY ASSOCIATION.

The Texas Street Railway Association has recently held a meeting in Dallas. The following officers were elected for the ensuing year : Col. W. H. Sinclair, of Galveston, president; C. A. McMinney, of Galveston, vice-president; C. L. Wakefield, of Dallas, secretary. These officers with George B. Hendricks, of Fort Worth, and W. H. Weiss, of San Antonio, complete the directory.

THE STREET RAILWAY ASSOCIATION OF NEW JERSEY has been formed, and several roads have joined. The officers are : President, David Young, of Newark; vice-president, G. S. Browning, of Camden; secretary and treasurer, W. B. Price, of New Brunswick.

MARRIED.

POOR—CAMPBELL.

On Wednesday, January 16, Mr. George Hamilton Poor was married to Miss Jennie Euphrasia Campbell. The groom is connected with the W. S. Hill Electrical Works and is well known among the electrical fraternity. Mr. and Mrs. Poor will live at Roxbury, Mass.

A CONTRACT FOR THE WESTERN TELEPHONE CONSTRUCTION CO.

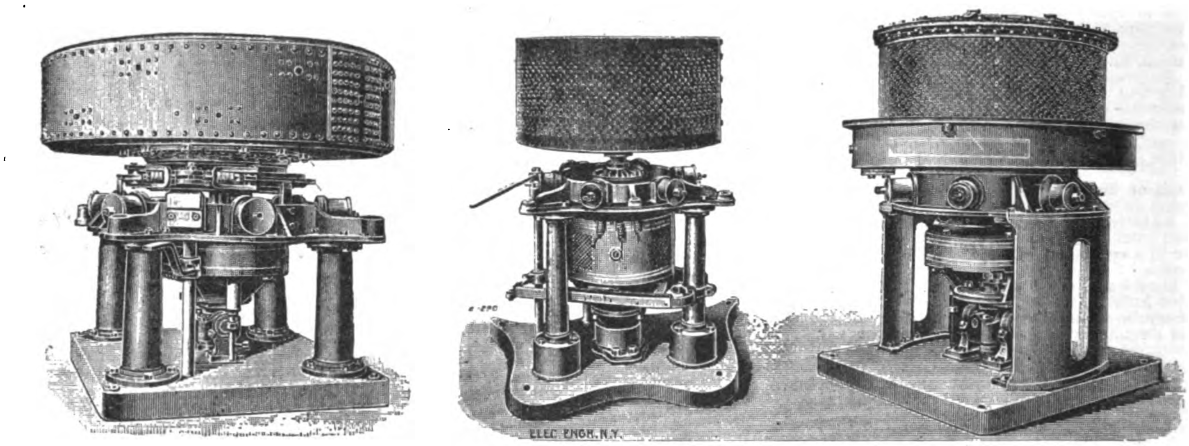
The Western Telephone Construction Co., of Chicago, Ill., has been awarded the contract for installing a telephone system in the Interior Department, their bid being $5,565.76.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

CENTRIFUGAL MACHINES DRIVEN BY POLYPHASE A. E. G. MOTORS.[1]

ALTHOUGH electric motors would appear to lend themselves particularly to the driving of centrifugal machines, which are, as a rule, run intermittently and at high speeds, their application for this purpose is at yet limited. The Allgemeine Elektricitäts Gesellschaft of Berlin considers that the ordinary continuous-current motor requires too much attention to become successful in this field. As centrifugal machinery cannot be expected to run very smoothly, there may be a good deal of sparking, and the care of the motor is troublesome, since the brushes and commutator have generally to be fixed below the drum. Their own polyphase motors have neither commutator nor brushes, and are, they say, better fitted to start under a heavy load and to maintain a uniform speed. The application of these motors for special work would, in many cases, mean the adoption of the polyphase current in general. This circumstance gives particular interest to some electric installations which the Allgemeine Elektricitäts Gesellschaft are now erecting; Messrs. P. Schwenger's Söhne, of Uerdingen-on-the-Rhine, are rebuilding their sugar works and arranging for polyphase electromotors throughout. The installations will comprise 91 motors of 490 horse-power total, coupled we are informed, in a novel manner. Two other sugar firms, Messrs. Fr. Meyer's Sohn, of Tangermünde, and Messrs. Schoeller, of Czarkowitz, Bohemia, have decided upon the adoption of the polyphase motor. The centrifugal machines, specially constructed for sugar works, are illustrated in Figs. 1 and 2. In this type the drum and its shaft rest in the patent revolving oil-pressure bearing of Messrs. Fesca and Co., of Berlin. The armature is keyed to the shaft; the annular pole-piece, between which and the armature there is a clear space of a few millimeters, can follow the oscillations of the shaft. Fig. 3 shows a different arrangement of the same type, tension-rods with rubber cushions being interposed between the upper bearing and the frame.



FIGS. 1, 2 AND 3.—CENTRIFUGAL MACHINES DRIVEN BY POLYPHASE A. E. G. MOTORS.

The Allgemeine Elektricitäts Gesellschaft supply four different types of centrifugal machinery in conjunction with various other firms. In the Weston type, built by Messrs. Watson and Laidlaw, of Glasgow, and Messrs. Orthwein, Karasinski and Co., of Warsaw, the whole apparatus is suspended on a shaft with ball-and-socket joint and the hollow shaft fitting over this rod carries the armature at its upper end. Five sizes of electromotors are at present offered. They vary in speed between 1,000 and 5,000 revolutions, and in power between 1 and 7 horse-power.

A THREE-PHASE PLANT AT PELZER, S. C.

The Pelzer Manufacturing Company, of Pelzer, S. C., has contracted with the General Electric Company for a three-phase electric transmission plant that will be exceptionally large and interesting. At the generating station, three miles from the cotton mills owned by the Company, there will be three slow speed generators of 750 kilowatts each directly coupled to water wheels. These dynamos will generate current at a potential of 3,300 volts and the current will be fed directly to the transmission wires at this pressure. The transmission line will consist of eighteen No. 00 wires, this size having been selected in preference to larger wire to reduce the line induction as much as possible under the existing conditions. At one mill will be located a 400 horse power synchronous motor, receiving current directly from the wires. There will be, in addition, more than twenty induction motors in various rooms. Of these fourteen will be 110 horse power motors and the others will be of various sizes, from 5 to 75 horse power. In a sub-station will be located nine 160 kilowatt transformers for the motors and for 1,200 incandescent lights for the mills. Two electrically operated blowers of three horse power each will be used for cooling the transformers.

1. London *Engineering*.

CATALOGUE OF THEATRICAL LIGHTING DEVICES.

The Electric Appliance Company are making a specialty of theatrical electrical devices and have secured control of a number of lighting specialties particularly adapted for theatre work. In fact this has become so important a department of their business that they have found it necessary to issue a special catalogue of this material under the caption of "Catalogue of Theatrical Lighting Devices" which is now being extensively distributed. The Electric Appliance Company will be pleased to send a catalogue to all interested, who have not received a copy.

GRAPHITE AS A LUBRICANT.

The development of high speed and great power machinery of the day has made the question of successful lubrication more serious than ever before. The compound engines, the great motors, the heavy shaft lines and gears, now so common in the large power plants and mills, present many new questions of friction and lubrication. With superheatad steam and high pressure there is difficulty in properly lubricating steam cylinders and valves.

Under these conditions pure flake graphite has solved so very many of the problems that it would seem to be the key to solve many others. It has been said that the more solid the lubricant that can be used in any place, the better the lubrication.

The Joseph Dixon Crucible Co., of Jersey City, N. J., have issued a third revised edition of their interesting treatise on this subject which cannot fail to interest power users.

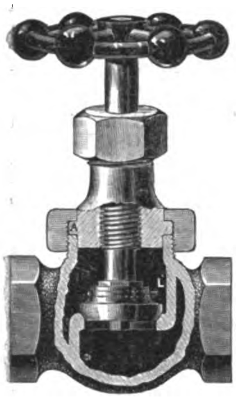
STREET RAILWAY EQUIPMENT OF THE NILES TOOL WORKS.

With the object of making repairs to the running gear of street railway cars quickly and at a minimum of cost the Niles Tool Works, of Hamilton, Ohio, have brought out an equipment of machine tools, which forms the subject of a little catalogue recently issued by them. It consists of an engine lathe which is complete with screw cutting attachment and compound rest so that it can be used for general work as well as turning and finishing car axles from the rough or for turning up rough or irregularly worn journals. In addition they have designed a 36-inch car wheel borer of the same general design as their standard 42-inch car wheel borer that has met with so much success for boring the larger wheels.

With the hydrostatic press for pressing the old wheels off and the new ones on the axle, the repairs to wheels and axles can be done quickly besides avoiding the cost of transporting these parts from the car barn to and from such shops as may be equipped to make such repairs.

These machines are heavy and most substantially built in all their details. They will turn out the best of work quickly. All driving shafts are solid forged steel or iron and all wearing surfaces are made large and the parts carefully scraped together.

LUNKENHEIMER'S REGRINDING VALVES.



Sectional View.

We present herewith a view of Lunkenheimer's regrinding globe valve, which possesses some features of special merit. Instead of the hub being threaded direct to the body of the valve it is merely fitted into it plainly and rests upon a flange which fits upon the upper edge of the opening, as shown in the accompanying cut. The hub is then secured by a nut, which fits over the flange, and is threaded to the outside of the body of the valve. The result of this arrangement is that the valve can be reground at any time with the greatest facility, because all that is necessary is to loosen the nut, remove the hub, place a little sand and soap under the disc, and then replace the hub, leaving the nut loose so that the hub is free to turn with the stem during the regrinding.

A piece of wire or nail is passed through a hole provided for that purpose in the lower end of the stem of the disc, so that the latter will turn with the stem during the regrinding, which of course it does not necessarily do when the stem is in use.

The hub being in place when the grinding is done, effectually centers the stem and holds it in proper place, so that the re-grinding is done correctly. The valve can thus be readily ground while in position, and in many cases this does away with the necessity for breaking connections. The disc is also easily replaced when required. These valves (on account of having an outside thread and union connection for holding the hub to the valve shell) are always easily taken apart, as the hub will not "cement" into the shell.

These valves are made of gun metal throughout, tested and inspected before leaving the works, and as a proof of their superiority, are extensively used in rolling mills, refineries, on locomotives and steamships, and in the United States Navy on cruisers, where the requirements are very severe. They are made by the Lunkenheimer Company, Cincinnati, O., the well-known manufacturers of brass goods for steam.

EUREKA TEMPERED COPPER CO.

The Eureka Tempered Copper Co., of North East, Pa., have issued their first illustrated catalogue, containing some forty pages of interesting matter relative to commutators (their specialty), commutator bars, bearings, brushes, trolley wheels, washers, springs, wire, etc. The pamphlet is well printed and interestingly written.

ALFRED F. MOORE.

Alfred F. Moore, of Philadelphia, manufacturer of insulated wires and cables, has issued a revised catalogue No. 13,—a 36-page pamphlet well illustrated in colors. Many of the flexible cords are shown in facsimile as to size and color, and the descriptions are sufficiently full to afford intending purchasers an excellent idea of the goods.

MORE SPRAGUE-PRATT ELEVATORS GOING IN.

The *Boston Globe* has just closed a contract with the Sprague-Pratt Electric Elevator Company of New York for two electric elevators. These will be the first high speed, direct connected electric elevators ever installed in New England.

The contracts for the new elevators in the New York custom house has been awarded to the Sprague-Pratt Electric Elevator Company, over all competitors, by the acting supervising architect of the Treasury Department.

ELECTRIC LIFE BUOY.

The Allgemeine Elektricitats Gesellschaft, of Berlin, is making a life buoy for use on board ship, which is fitted with an electric lamp so as to be visible at night in the water. The floating apparatus is made of waterproof linen, and is sufficient to bear the weight of three persons in the water, life belts being attached to the buoy. Inside the canvas buoy is a double wooden box containing an accumulator with gelatinous electrolyte, such as that made by Dr. Paul Schoop, and it is capable of feeding an incandescent lamp for six hours. The incandescent lamp surmounts the floating buoy in a strong wire frame, and is further protected by an outer strong glass globe. When the apparatus is hanging on board ship, the weight of the lower portion automatically switches off the current, but as soon as the buoy is released and dropped into the water four powerful springs switch the current on. The accumulator will last for two months before requiring to be recharged, so that the apparatus can be employed on board ship where there is no dynamo. The apparatus weighs about 100 pounds, but the accumulator can be made smaller with, of course, a corresponding decrease in the duration of the light.

F. W. GARDINER, M. E.

The importance of testing the quality of the material employed in the rails and angle plates of electric roads is well set forth in the article appearing on another page in this issue, and our readers will be glad to know that this work is made a specialty of by Mr. F. W. Gardiner, M. E., of No. 493 Manhattan Ave., N. Y., late engineer of test for Dr. P. H. Dudley. Mr. Gardiner makes a specialty of drawing up specifications, tests and inspection for steel rails and angle plates for electric railways. He also acts as inspector for bridge steel and structural steel and iron work; and furnishes designs and calculations of stresses for bridges, roofs and all framed structures.

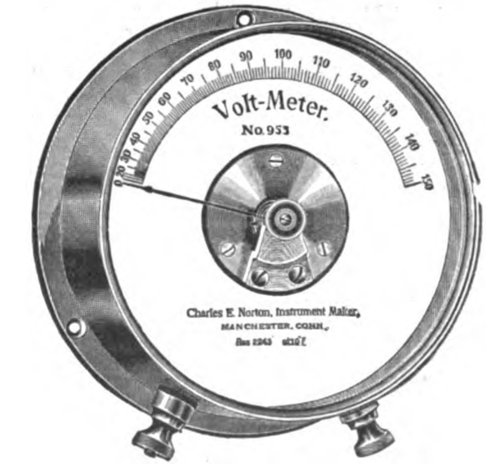
THE WHITE-CROSBY CO.—AND THE BROOKLYN STRIKE.

The striking of the linemen of the Brooklyn railways for a time was even a more serious blow to the companies than the going out of the motormen, as their places could not be filled so easily, and line cutting began to increase directly after the linemen had declared their intention of quitting work. The companies were therefore obliged to obtain skilled linemen from other places. The Atlantic Avenue R. R. Co. early applied to the White-Crosby Co. for assistance and within 12 hours the latter company brought on 19 men from Baltimore, where they had been employed on the White-Crosby Co.'s work on the Suburban Road now building. Within 48 hours the lines of the Atlantic Avenue Co. were in full working order and have been maintained in that condition ever since.

It is worthy of remark that the White-Crosby Co.'s linemen were not molested in the least, which is probably largely due to the fact that they took the precaution of covering the company's sign on the repair wagon with one bearing the name of the White-Crosby Co.

THE NORTON AMMETERS AND VOLTMETERS.

The accompanying engraving illustrates the general design of the indicating instruments made by Mr. C. E. Norton, of Manchester, Conn., who has had a wide experience in the manufacture of high grade instruments. Each instrument is carefully calibrated by a known standard and the scale made by hand. The object of the designer has been to construct an instrument which should



The Norton Voltmeter.

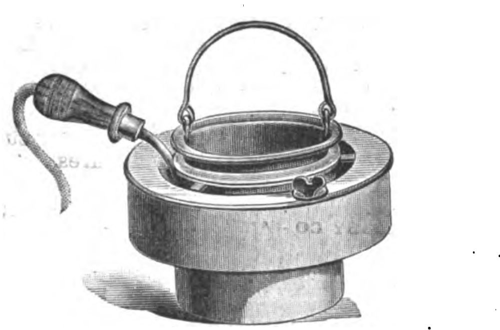
combine working accuracy with neatness in design and cheapness. Mr. Norton's shop is equipped with the latest improved tools; and besides the manufacture of instruments he gives special attention to electrical experimental and repair work. The office and factory are situated at Manchester, Conn., on the main line of the New York & New England Railroad.

Mr. F. A. Schulz has offered a bill in the New York Assembly providing that no street surface railroad shall hereafter be granted a franchise unless it gives a bond exempting a city, town, county or village from damages to such company as the result of a strike.

THE CENTRAL ELECTRIC HEATING COMPANY'S GLUE POT.

The accompanying illustration shows an electric glue pot which is being introduced by the Central Electric Heating Company, of the Havemeyer Building in this city. The glue is kept hot in a vessel set in a water bath, the water in which is kept at the boiling-point by an electric heater. The loss of water from evaporation is made good by automatic feed from an annular reservoir surrounding the water bath and containing a supply that will last for five hours at least.

All that needs to be done is to fill the reservoir in the morning



ELECTRICALLY HEATED GLUE POT.

and turn on current about half an hour before beginning work. In factories this can be attended to by the watchman, so that the glue in each pot is ready to be used when the men begin work. By repeating the same operation at noon, the supply for the afternoon is provided for, and thus the employé is sure of a constantly and evenly heated glue pot.

The amount of current required for each pot is about two amperes on 110 volt circuit, or about the equivalent of four 16 candle-power incandescent lamps.

In large plants, all the pots can be connected to one large reservoir holding enough water for several days run, and the current can be kept on without regard to filling the water reservoir.

NEW YORK NOTES.

MIDDLETOWN, N. Y.—The Middletown & Goshen Traction Co., have placed a contract for a new car barn with The Berlin Iron Bridge Co., of East Berlin, Conn.

THE NATIONAL SCHOOL OF ELECTRICITY is arranging with the help of Dr. W. J. Morton and others for a special course of forty lectures in electro-therapeutics for the benefit of physicians.

THE ACTON VALVE & STEAM SPECIALTY CO., of 79 & 81 Washington street, Brooklyn, N. Y., have just issued a new catalogue of their steam and water works specialties which will be sent to anyone interested upon receipt of address.

The Boynton Multivolt Battery Co. has been formed in Brooklyn to make and sell electrical apparatus, etc. The capital stock is $10,000. The directors are Edward S. Boynton, of Brooklyn; A. Strauss, P. Kemble and C. H. Brigham of New York City

WESTERN NOTES.

MR. C. E. BROWN, Secretary of the Central Electric Co. is again at his desk, receiving the congratulations of his friends on his successful recovery from a rather tedious attack of typhoid malaria.

THE HARRISON ELECTRIC CO., at Chicago, has been incorporated with a capital stock of $500,000 to manufacture electrical machinery. The incorporators named are Edward M. Harrison, Lewis H. Painter and Lewis Rinsker.

NEWMAN, ILL.—B. Thomas, Jos. Venders, L. W. Root and others have organized and incorporated the Newman Canning and Electric Light Co. with a capital stock of $40,000. Work will be begun soon.

THE WALKER MANUFACTURING CO., of Cleveland, Ohio, have issued a folder describing and illustrating their Ballantine automatic grease cup. This cup has a taper stem varying the size of the discharging hole, and a spring varying the pressure, giving a regular and constant feed.

MR. E. W. COOKE, Monadnock Block, Chicago, has just completed arrangements for representing the Eastern Electric Cable Co. as manager of their western office. This will no doubt prove a valuable addition to the several specialties already secured by Mr. Cooke, and will give the western customers of the "Clark" wires an opportunity to have orders filled promptly from Chicago.

THE METROPOLITAN ELECTRIC COMPANY have just taken the agency for the American Carbon Co.'s products and will carry a full line of this celebrated carbon. They will have their stock in in a very few days and will be able to meet the demands of the market. This adds another high class specialty to the Metropolitan Company's list.

ROBERT LAIDLAW, president of the Laidlaw-Dunn-Gordon Pump Co. of Cincinnati, was elected treasurer of the National Association of Manufacturers, which convened at Cincinnati the third week in January. Mr. Laidlaw was one of the leading spirits in organizing the association and much of the success of the convention was due to his superior executive skill and untiring energy. The delegation was banqueted at the new plant of the Laidlaw-Dunn-Gordon Pump Co.

THE BALL ENGINE CO., Erie, Pa., continue to keep their shops well filled with work, and have recently taken some good sized orders. Among recent shipments of electric light engines are the following: Oskaloosa, Ia., Edison Light Co., two 175 H. P. direct connected engines; Chesapeake Light & Power Co., Hampton, Va., one 300 H. P. cross compound; Peninsular Electric Light Co., Detroit, Mich., one 150 H. P. cross compound; Dunkirk, Ind., Electric Light Co., one 100 H. P. tandem compound; Barnesville, O., Gas & Elec. Lt. Co., one 80 H. P. single cylinder; Washington, Mo., Electric Light plant, one 50 H. P. single cylinder; Norfolk Navy Yard, Portsmouth, Va., one 80 H. P. single cylinder; Yngo Soledad Plantation, Guantanamo, Cuba., one 35 H. P. single cylinder; Canon City, Col., Elec. Light & Power Co., one 100 H. P. single cylinder; Sweetwater, Tenn., Mill Co., one 25 H. P. single cylinder; Crook, Horner & Co., Baltimore, Md., one 125 H. P. single cylinder; L. M. Rumsey Mfg. Co., St. Louis, Mo., one 60 H. P. single cylinder; and others.

MESSRS. REID CARPENTER, President, Geo. F. Card, Electrician and John F. Card, Supt. of the Card Electric Co., Mansfield, Ohio, spent several days of last week in Chicago. Mr. Carpenter states that the indications for a prosperous business year are exceedingly favorable, orders are coming in fast and their factory is now running full time. Among their recent sales we note the following: Citizens' Street Railway Co., Mansfield, Ohio, 2-single 35 H. P. equipments, and 1 double 35 H. P. equipment; Elkhart & Goshen, Ind., 6 single 35 H. P. equipments, 2 double 25 H. P. equipments, and 2 double 35 H. P. equipments; Bloomington, Ill., Street Railway Co., 1 double 25 H. P. equipment; Lincoln, Ill., 1 double 25 H. P. equipment; J. E. Tomlinson, Centreville, S. D., 1 35 KW. multipolar dynamo; E. C. Hargrave & Co., Hinckley, N. Y., 1 30 KW. multipolar dynamo; Mansfield Machine Works, Mansfield, Ohio, 1 30 KW. generator with multipolar motor equipment; The Altman & Taylor Machinery Co., Mansfield, Ohio, 1 30 KW. multipolar dynamo; Fulton Truck & Foundry Co., Mansfield, Ohio, 1 30 KW. dynamo; J. Holt Gates, St. Louis, 1 30 KW. multipolar dynamo, and one of same size for Chicago; U. S. Baking Co., Louisville, Indianapolis, 2 25 KW. multipolar dynamos; Geo. P. Nicolls, Chicago, 1 15 H. P. multipolar generator, Niagara Engineering Co., Buffalo, N. Y., 1 12 KW. machine, besides numerous other multipolar motors and dynamos of small sizes. For the Niles Tool Works, Hamilton, Ohio, a large special iron-clad reversible motor for working boiler plate rolls. This motor will be controlled by special reversible controller with long lever handle. The Card Company are making a specialty of this class of work.

NEW ENGLAND NOTES.

UXBRIDGE, MASS.—An attempt is being made to establish a telephone exchange in town.

THE HON. JOHN C. BURKE, of the law firm of Marshall, Burke and Marshall, has recently been elected to the presidency of the Bradbury-Stone Electric Storage Co. of Lowell, Mass.

NATIONAL GLASS CO. has been organized at Portland for the purpose of manufacturing glass insulators and a line of glass electrical goods with $250,000 capital stock of which $125 is paid in. The officers are: Robert J. Dolan of Boston; treasurer, Chas. H. Jenkins of Boston.

THE following is a copy of a special telegram to the *Berliner Tageblatt*, Berlin, of Jan. 8, '95 from Hagen i/Westphalia, Jan. 7, 1895:—"The electric street line of this city with storage battery equipment (the first in Germany) is opened to-day with great results. Guests of the Accumulatoren Fabrik Muller and Einbach were present, among them being electricians, engineers, directors, etc., from far and near." The batteries here referred to are, we understand, based on the Waddell-Entz patents in the hands of the Accumulatoren Fabrik.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. FEBRUARY 13, 1895. No. 354.

THE UTILIZATION OF WATER POWER IN CALIFORNIA.—THE FOLSOM-SACRAMENTO TRANSMISSION.

BY

George Heli Guy.

SOME time since, the announcement was made that the contract for the installation of an electric transmission plant between the town of Folsom, Cal., where the Folsom Water Power Co. has developed one of the largest water powers available in California, and the City of Sacramento had been awarded to the General Electric Co. and that work upon this important undertaking was to be expedited. A full description of the installation has not yet been published, but by the courtesy of Mr. Albert Gallatin, the president of the company, some data have been made available which indicate that as a power transmission the scheme is in magnitude second only to the Niagara plant, which in many respects it equals in interest. As a matter of fact work has been so diligently prosecuted on the hydraulic end of the scheme for several years past that this work was practically completed before the awarding of the contract referred to.

It is proposed to dam the American River near Folsom and divert its waters, first for power purposes, and secondly for the general irrigation of the entire surrounding country. The magnitude of this undertaking will be understood by the fact that 5,000 horse power will be shortly available for electric transmission purposes, and about 1,200 horse power for use in the Folsom State prison which is adjacent. In addition to this it is proposed to largely supplement the power capacity of the installation by a series of impounding reservoirs on the line of the river in the mountains. The extent of the possibilities in irrigation are indicated by the fact that 400,000 acres of land can be brought under cultivation by means of the water from the tail races.

The foundation for the dam was laid in 1866 and since then the work has been continuously in progress. It was soon recognized that the scheme would accrue in such a marked degree to the benefit of the community that the State of California became interested in the work, and an agreement was entered into whereby the State received from the Company a conveyance for the site of the prison, and a grant of water power privileges of the canal, at the prison, in consideration of giving the aid of convict labor in the construction of the dam and canals. In 1874 additional concessions of land were received by the State allotting the site for the proposed State Prison, in return for additional grants of convict labor to construct the work. The completion of the Prison was delayed and it was not until 1881–2 that the State commenced to discharge its contract to furnish convict labor. There were further interruptions in consequence of differences of interpretations as to the contract, but in 1888 a new contract, at the suggestion of the late Governor Waterman, was entered into between the State and the Company, providing for a large increase in the magnitude of the dam and canals, for a proportionally more ample water power privilege to the State at the Prison, and for a correspondingly increased contribution of convict labor by the State. Under this expanded contract the work is now rapidly approaching maturity.

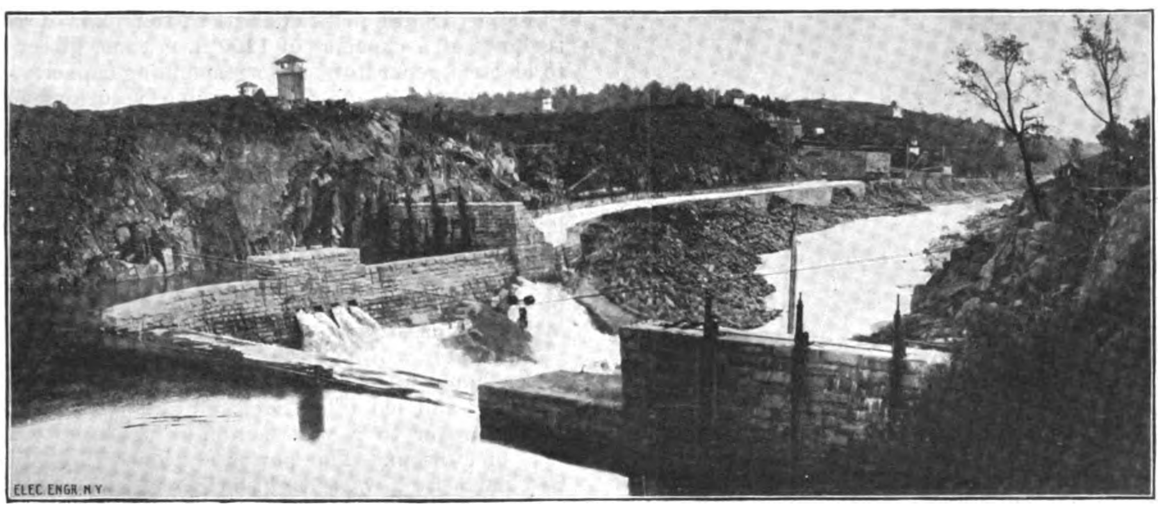


FIG. 1.—THE FOLSOM-SACRAMENTO ELECTRIC POWER TRANSMISSION.

To put it broadly, the nature of the contract is as follows : The State is to construct a dam and all the mason work of the dam and canals by State prison labor, and in return is to receive 1200 horse power, to be delivered at the State power-house, situate on the canal about 100 feet below the dam. The canal is forty feet wide at the bottom, fifty feet wide at the top, and eight feet deep, and has a capacity of 84,000 cubic feet of water per minute As shown in Fig. 1, it follows the bank of the river, and

has been constructed partly with masonry walls, partly by deep cuts in solid rock, and partly by earth excavation and filling.

Just before reaching the power-house site an immense log basin has been constructed, to hold the logs of the American River Land and Lumber Company, for supplying a large saw mill which will soon be erected at this point. This mill will receive sugar pine timber from the woods of El Dorado County, for which, heretofore, there has been no outlet. It will be operated throughout by electricity, and will be a model of the most modern developments in saw mill construction.

The power house of the Sacramento Electric Power and Light Company is located on the west side of the town of Folsom, just opposite the centre of the business portion of the town, and almost within a stone's throw of the Post-office. An immense cut in solid rock has been made some sixty feet deep, 100 feet wide, and 150 long. In this cut the massive masonry foundations for the machinery and superstructure of the building have already been laid, and the granite walls, piers and arches are rapidly rising to

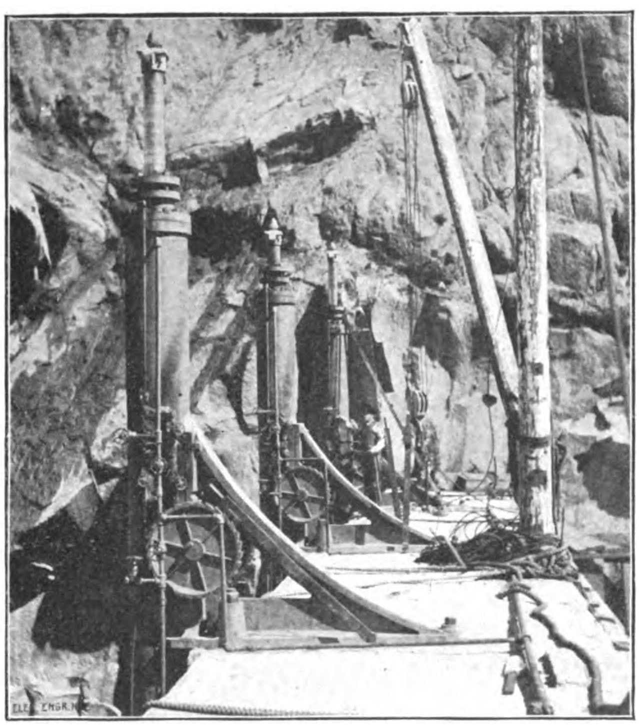


FIG. 2.—MECHANISM CONTROLLING THE HEAD GATES.

form a completed building, in which vast quantities of water are to be controlled and their energy transformed into electric power. From the canal, which at the power house has been widened out into a forebay 150 by 100 feet, and ten feet deep, steel inlet pipes eight feet in diameter lead the water to the water wheels. The dam is 650 feet long, 24 feet wide at the top, 87 feet wide on the bottom, and 89 feet high at the highest point. It contains 48,590 cubic yards of granite masonry. The storage bason or reservoir is 3½ miles long and has a holding capacity of 13,000,000 cubic yards of water. The mason work is all of the most solid character, and is laid in Portland cement of which over 20,000 barrels were consumed in the dam headworks. The passage of water into the canals is controlled by massive head-gates on either end of the dam, each head-gate being 25 feet in width. The canal on the west side of the river has yet to be constructed; but the east side canal is completed from the dam to the site of the power house at Folsom about two miles below.

The dam contains two entirely novel features, namely, the method by which the main head-gates are controlled and the method by which the impounding capacity of the dam may be increased at will. The engraving, Fig. 2, shows the hydraulic mechanism controlling the head-gates. These are operated by water power under high pressure which is obtained by means of special hydraulic accumulators, manufactured by the Risdon Iron Works of San Francisco. The second novel feature consists of a shutter made of heavy planking and securely truss braced, which in its normal position rests across the top of the dam along the entire length of its crest. Usually the water flows over this, forming a waterfall; but in periods when a scarcity of water is apprehended the shutter is raised, the overflow is arrested, and the depth of water in the dam is increased by over six feet. The engineering interest attaching to this achievement will be evident when it is remembered that the width of the overflow is 200 feet.

About a thousand feet below the dam the canal passes by and through the State power-house, gates being so arranged that either all the water or only as much as is needed, may go through the State water wheels. In accordance with the admirable provision throughout the whole installation for perfect economy of water, the water here is not lost but continues down the canal, at a slightly reduced head, having fallen 7.3 feet in passing the State power-house, where 1200 horse power can be developed by this loss in head. The canal is divided into three sections, and is about two miles in length, the power-house being situated at the extreme end where a fall of 55 feet will be available. The power-house is of stone, two stories high, the water wheels and generators being located on the lower floor, twenty feet above the level of the tail race.

The hydraulic plant consists of four pair of McCormick turbines of a capacity of 1200 H. P. each, direct connected to electric generators of corresponding capacity, which run under a head of 55 feet at 350 revolutions per minute. There are also two exciter wheels direct connected in a similar manner. These wheels are manufactured by the S. Morgan Smith Works, of York, Pa., under contract with the Pelton Water Wheel Co., of San Francisco, and are of larger capacity than any so far constructed in this country with the exception of the Niagara plant. As they embrace many new features covering the most advanced practice in electric and hydraulic engineering, their operation will attract much attention.

The water will be discharged through tunnels under the power-house into open cuts to the river, or may be again taken up and led into irrigation canals for supplying irrigating water to a vast section of the country south and east of Folsom. The power station will be divided into two parts by a water-tight masonry wall, thus separating the waterwheel plant, with its pipes, gates, etc., from the electric generators, switchboards, transformers, etc., of the dynamo room. In the dynamo room there will be four three-phase alternating current generators of the General Electric Co.'s type, each capable of developing 1,000 horse-power, the shafts of which will be coupled direct to the shafts of the four water-wheels. These generators have been under construction at the works of the General Electric Company at Schenectady, N. Y., for the past four months. They weigh 40 tons each, and are the largest in the world except those being built for the Niagara Falls power plant. The current developed by these dynamos will be passed through step-up transformers, and after being raised to 10,000 volts, it will pass to the transmission line.

All possible delay or shut-down for repairs or renewals will be guarded against by the erection of a double-pole line all the way from Folsom to Sacramento, a total distance of about 24 miles. About 2,600 poles will be required for these lines. They will be of red cedar, 40 feet long, 16 inches in diameter at the butt and when erected they will constitute a pole line of exceptionally enduring character. Each pole line will be fitted with two cross arms, containing 6 bare hard-drawn No. 0 copper wires supported on double petticoat porcelain insulators, consti-

tuting two circuits, each 3-wire circuit corresponding to one dynamo, at the power-house, and capable of transmitting 1,000 horse-power to Sacramento.

When it is realized that each wire is only one-fourth of an inch in diameter, and that three of them will transmit 1,000 horse-power 23 miles, some idea of the flexibility of electrical energy can be obtained.

The transmission line will follow the county road from Folsom to M and Thirty-first streets, thence north on Thirty-first street to the alley between D and E streets, thence east in the alley to Sixth street, thence by the alley between Front and Second streets to Y street—twenty-four and one-half miles.

The power is all brought into a sub-station, passed through step-down transformers, which reduce the voltage from 10,000 volts to about 100 volts, when it is ready for distribution for incandescent and arc lighting, operating the entire street railway system, running motors, heating, cooking, and all the multifarious uses to which electricity is now being put.

In the sub-station, which will be an imposing fire-proof brick structure of two stories, will also be located all the regulating and controlling devices with which to operate the distributing system.

It is safe to say that the future of the electrical power transmission of California depends very largely on the outcome of this remarkable installation, and the progress of the work of construction is being eagerly watched, particularly by mining interests.

REMINISCENCES OF THE LATE RUDOLF EICKEMEYER.

BY DAVID E. LAIN.

Rudolf Eickemeyer.

THE writer was quite intimately associated with Mr. Eickemeyer during several years of his most aggressive electrical work; and now, that this master mind can no longer cheer his friends with counsel, advice, and criticism, the opportunity to give these few brief reminiscences is gladly embraced.

The subject of this sketch possessed a mental equipment far above the ordinary, both as to insight into the true inwardness of things and ability to use his mind continuously and for long intervals on one subject. Besides this, his mind had a decided mechanical bent and was very resourceful in devising original expedients. Then his painstaking and thorough methods, and the habit of recording in his journal all that he did or thought in connection with the subject on which he was working, gave him the advantage of having always at hand a synopsis of what he had previously accomplished in that connection.

Mr. Eickemeyer's first considerable successes in mechanical invention and construction were in connection with hat machinery. When his attention was first called to this branch of industry, the machinery used in the manufacture of hats was very limited and crude. Most of the processes were almost entirely performed by hand, and the hatters of those days were at once marked by their calloused and distorted hands and fingers.

One effect of his work in the field of hat machinery has been, as he remarked to the writer on one occasion, to so nearly succeed in producing machine-made hats that the hatters of to-day are no more noticeable than other well dressed citizens; and the saving which has been brought about by machine processes has been used to improve the quality of the manufactured article.

Mr. Eickemeyer's mind moved along intensely practical lines. The most casual observer cannot help but notice indications of this in his hat machinery. For, although such machinery is necessarily complicated, his machines are so simplified in construction that, to one who did not know what their functions are, they might appear as not only very simple but also as very roughly built. Yet these machines have been so carefully worked out, both in accordance with what they were to perform and the methods to be used in their manufacture, that the greatest simplicity of construction was obtained, and yet all necessary precaution taken concerning the most minute details.

When Mr. Eickemeyer turned his attention to electrical work, he found that the mechanical requirements of this new field were so much simpler than in that with which he was so familiar, that it seemed like a much easier task to design electrical machinery than hat machinery. Still his effort always was to make the fewest parts of the simplest form serve the purpose. Before the writer's first acquaintance with him, he had been engaged in quite an extended research in the field of the transmission of speech by the electric current, and had entered into the work so thoroughly and to such an extent that his health had broken down and he was obliged to give up these investigations. On the return of his usual health he continued his electrical work, but in the direction of improving generating machines and motors; and he never returned, with the old-time concentration, to the investigation of telephone apparatus.

He obtained his knowledge of electricity from treatises on that subject, almost entirely unaided. And, although he informed himself quite minutely as to what had been accomplished by other inventors who were designing electrical machinery, he did not follow the lines which they had marked out, but chose paths of his own, which ultimately led him to very satisfactory results.

Some insight into his mental processes may be discovered by a comparison between his dynamo and the best types of dynamos on the market or described in Patent Office reports at the time when he invented his dynamo electric machine. The practice then was to produce magnetic lines of force in one part of the machine, and convey them through the field magnet cores to the pole pieces between which the armature revolved. Now he was quick to see that opportunities for loss must occur by the separation of the place where these lines of force were generated from the place where they were used. So, instead of putting his field coils around field cores, as was then the universal practice, he placed his field coils around the armature, doing away entirely with the field cores. The accomplishment of this was the first step toward the invention of his iron clad dynamo. The machine on which he first practically carried out this construction in any very large way was a Weston arc light dynamo with a Gramme ring armature.

In order to get some comparison between the efficiency of his method and the common one, he took precisely the same amount of wire of similar size as that which he found in the field of the Weston machine, and made field coils to surround the armature, after his own plan, and then enclosed the whole machine in a jacket of iron. The improvement was considerable both in the diminished size of the machine and its increased output. He was not long in discovering that the hole in the centre of armatures of the Gramme ring type required him to use a greater length of wire in his field coils than would be necessary if he adopted an armature of the Siemens type. He therefore concluded that armatures of the Siemens type were better suited to his new field windings.

But here occurred a very considerable difficulty. As soon as he investigated the construction of the Siemens

armature, he observed the large and unsightly bulging ends which were caused by the many crossing wires at these parts of the armature, and concluded that it might be nearly as wasteful to wind his field wire about such useless spaces as were occupied by these overlapping wires as to build it around the Gramme ring armature. Furthermore, a method of armature winding that required such a construction as was then used in Siemens armatures appeared to him to be very unmechanical as well as unsightly. So he set about the designing of a new method of making the coils for Siemens armatures, with the result that he invented an armature coil which could be wound on forms apart from the armature core, carefully examined and insulated, and then with others of exactly the same size and shape assembled on the core; making an armature winding composed of coils of exactly the same shape and length of wire. His completed armature was a cylinder with perfectly flat ends, and this, of course, suited his new field construction. After the practicability of his new armature winding was demonstrated, he was not long in designing and building a dynamo which contained all of the essential features of the now well known Eickemeyer iron clad dynamo electric machine.

During all of this time he was adding to his store of electrical knowledge both by reading and experimenting, and his efforts to improve the efficiency of electro-generating machines very soon led him to feel the need of some simple method of measuring the relative magnetic conductivity of different kinds of material. His needs in this direction were the cause of his inventing the Eickemeyer magnetic bridge, which affords a sufficiently accurate means of comparison between magnetic conductors to furnish the manufacturer with all necessary data of this kind. After the invention of this measuring instrument, he obtained samples of cast iron from various foundries in the vicinity of his shop, and by comparing these samples on his magnetic bridge, he easily determined which was most desirable to use in the construction of his dynamos. And then with each dynamo frame he arranged so that a testing piece was cast in the same mould. This test piece gave him an opportunity to determine, on his magnetic bridge, the value of the frame as a conductor of magnetism.

The intense magnetic field and economy of space which were characteristic of his dynamo and motor made that form of machine very suitable for street railway work, and he accordingly undertook the development of an electrical street railway system of his own. In the construction of this system he began by using a differential gear to connect the fast revolving armature shaft with the slow revolving wheel shaft. This differential gear was a modification of a form with which he had experienced gratifying success at an earlier time when using it in mowing and harvesting machines. But for railway work it did not prove entirely satisfactory, and was soon abandoned, and a railway motor was built in which the armature shaft was coupled by connecting rods to the driving wheels.

However, for this machine Mr. Eickemeyer must have felt some apprehension, because an unfortunate mistake made by a machinist in drilling the holes through the crank discs threw the alignment of the crank pins sufficiently out so that the machine could not run perfectly; and this disappointment was sufficient to discourage him from going further with the direct connection construction at the time; and this machine was put one side for nearly two years.

He next designed a railway motor which was a combination of both the direct connected and the geared methods. In this he transferred by connecting rods the motion of the armature shaft to a shaft placed parallel with and over the wheel shaft; and then connected this countershaft to the wheel shaft by plain spur gears. It will be seen that this construction permitted the weight of the motor to be entirely spring supported and yet be connected with the wheel shaft in such a way that the transmission of power could be carried on without any possibility of cramping the mechanism. Mr. Eickemeyer always insisted that the weight of a railway motor should be entirely spring supported, and charged the great destructiveness to rails attendant upon the running of the railway motors of those days to the fact that a large part of the weight of those motors came rigidly on the axles.

Several railway motors, of the combined type referred to were built and successfully run. But Mr. Eickemeyer could not forget his hopes in regard to an entirely directly connected railway motor. So he finally decided to take his first direct connected machine from the corner in which it had been stored and put it in perfect mechanical condition. This was accordingly done and he always referred to this particular machine as the writer's "baby." From this machine was developed the well known Eickemeyer-Field direct connected street railway motor.

While engaged in some of his earliest electrical experiments his attention was called to the, in some respects, peculiar action of interrupted and alternating currents, and he pursued extensive investigations in this branch of electricity. While conducting some experiments, he succeeded in building a machine in which he caused an iron disc to be continuously revolved by an intermittent magnetic field. This machine he called his "whirligig," and, considering the date of its invention, it must be conceded to be one of the earliest alternating current electric motors.

Mr. Eickemeyer's method of thinking required him to first be reasonably sure of his premises and then to follow out the various steps to the conclusion with great care, so that, when he had finally arrived at a conclusion he felt reasonably sure that it was a right and safe one. And it was not easy to induce him to change his mind upon a matter after he had reached his conclusion in his usual painstaking and thorough way. Yet he was inclined to regard his electrical work with so much modesty that he frankly admitted that were it not for the assurances of the practicability and ultimate success of his electrical devices given him by Mr. Stephen D. Field, he probably never would have had sufficient faith in the value of his own work in electrical engineering to have placed his machines on the market.

Mr. Eickemeyer did not confine his reading and study to mechanical and electrical subjects. But he was a wide reader and thoroughly conversant with the best thought of the times in literature, art, and science. His mind was unusually well balanced for one who possessed such marked ability in original mechanical research. His business ability and judgment were conceded by his partners to the extent that his counsel was always sought even in purely business matters. His varied attainments, sound judgment, and patriotic instincts made him an invaluable assistant in municipal affairs, and for many years he rendered distinguished service on the most important official boards of the city of Yonkers. And the writer has often been surprised at the willingness with which he would cease some interesting and important investigation in order to attend to some public duty.

Space does not permit of more than these few brief references to some of the events of a long and busy life. But perhaps enough has been said to call attention to the original lines along which his mind worked, and the success that followed his persistent efforts and painstaking, methodical ways.

[The portrait at the head of this article is reproduced from a photograph by the celebrated amateur, Mr. R. Eickemeyer, Jr., and was the favorite picture of the late Mr. Eickemeyer, his father. Our biographical sketch appeared last week. Eds. E. E.]

Columbus, Ga.—The Southern Bell Telephone Company contemplate the extension of their long distance telephone to Columbus.

ELECTRIC TRANSPORTATION DEPARTMENT.

DESTRUCTION OF THE GRAND AVENUE POWER STATION, DENVER, COL.

On Wednesday, Jan. 30, a boiler explosion occurred in the Grand Avenue power station of the Denver Tramway Co., causing the death of two employés, the injury of a number of others, and the wrecking of the entire plant.

The direct cause of the explosion is still undetermined. The boilers, 12 in number, were of the horizontal tubular type, 125 H. P. each, built by the Variety Iron Works, of Cleveland, and were provided with Murphy stokers. The boilers, it is said, were all directly connected, and the explosion of one was followed by that of the others in succession. The electrical equipment of the station consisted of 12 Thomson-Houston 80 H. P. and 2 M. P. 400 H. P. generators.

The circuits fed from this station have been connected with the other power stations of the Denver Tramway Co., and traffic was only temporarily interrupted. The damage wrought by the explosion is estimated at $100,000. Our engraving gives a view of the wrecked buildings taken immediately after the explosion.

VIEW OF THE GRAND AVENUE POWER STATION, DENVER, COL., AFTER THE BOILER EXPLOSION.

MASSACHUSETTS STREET RAILWAY STATISTICS.

The report of the Massachusetts Board of Railroad Commissioners shows that there are at present in the state sixty-eight street railway companies, fifty-six in operation, with a total length of track, not including sidings, of 928 miles, an increase of 54 miles over the preceding year. Of this total, 825 miles are operated in whole or in part by electric power, and 103 wholly by horse power. This shows, as compared with the previous year, an increase of 113 miles equipped with electric power, and a decrease of 59 miles equipped for horse power only.

The aggregate capital stock of the sixty-eight companies is $26,971,275, an increase of $1,087,700 over the previous year. The whole amount of cash dividends paid was $1,610,886. The average rate on capital stock of the thirty companies, which paid dividends was 7 per cent., as against 8.22 per cent. the previous year. The aggregate funded debt of the companies Sept. 30, 1894, was $19.188,000, an increase of $5,079,000 over the previous year.

The total number of passengers carried was 220,464,099, an increase of 6,912,000 over the previous year. The total income was $11,236,428, and the total expenditures $11,034.616, leaving a net balance of income for the year of $201,782 to carry to surplus account. The ratio of operating expenses to gross income from operation has fallen in the last five years from 78.40 to 69.51 per cent. The whole number of persons injured was 1,341, of whom 29 received fatal injuries.

THE SUPPLEMENTARY WIRE FOR ELECTRIC RAILWAY WORK.

BY

Jno. C. Henry

IN THE ENGINEER of Jan. 16, Mr. H. S. Wynkoop, contributes an article on "The Supplementary Wire for Electric Railways." After referring to Mr. J. H. Vail's admirable paper read before the National Electric Light Association your correspondent thinks it strange that "this sudden awakening to the importance of an improved track return has not led to the abandonment of the supplementary wire." I may be in error, not having the paper referred to at hand, but my impression is, in the plan there advocated by Mr. Vail a supplementary track conductor was one of the important elements. Your correspondent attempts to explain the reasons which led to the general use of the supplementary conductor; but he entirely omits the most important object to be gained by its use, which is, to ensure a metallic return around defective rail joints should any occur from *any* cause.

To inform electricians at this late day that the sectional area of the ordinary track rails afford a surplus current carrying capacity for electric roads is rather stale information. While I do not doubt that it is possible to depend solely on some form of rail connection and that the supplementary wire may be dispensed with, it opens thousands of chances for failure which do not exist in the present practice.

In 1890 in the *Street Railway Journal* I sounded the alarm (which was based on practical experience) concerning the destructive effect produced on uninsulated copper wires buried in the earth, and also of the galvanic effect (which meant destruction of material) where copper and iron were joined together in damp locations, i. e., at the rail joints. Notwithstanding this experience as reported, and the many subsequent warnings, my observation is that on a large majority of the electric roads the unnecessary resistance is much greater than would be tolerated for a day on any well managed electric light installation or telegraph line.

Criticism has not much force unless suggestive of remedies. Kipling says, "There's a dozen ways to Heaven, *and every one is right.*" It is evident there are numerous solutions to the railway problem referred to. The double overhead system entirely avoids it. I know of some first class consulting engineers who in projected work are so hemmed in by municipal and other requirements that they are inclined towards the double wire overhead

construction. I believe if a few of the modern roads were to adopt it, the others would follow like a flock of sheep.

Where the track rails are used, the supplementary wire should be a well insulated one; where the copper is exposed at the rail and other connections, it should be carefully painted with paraffine paint. The supplementary wire should be exposed at intervals and switches provided for the insertion of an ammeter, so that the proportion of the current carried by the supplementary wire could be measured, which would be an indication of the condition of the rail joints. By simultaneous readings, at different points, defective joints can be located with ease and certainty. U. S. Patent, No. 508,615 of Nov. 14, 1893 deals more explicitly with this method.

Your contributor informs us that "the Feeder and Main patent is dead." I beg leave to inform him that the feeder patents as applied to electric railroads, are in a very healthy condition at the present writing. I do not understand his statement that "there are no longer systems of overhead construction." He certainly must know there are numerous ones.

HOW SHALL THE TROLLEY BE APPLIED ON STEAM ROADS?

OUR recent editorial on the changes which the substitution of the trolley for the steam locomotive is likely to bring about has elicited a number of communications on the subject, involving the methods best suited to the existing conditions of affairs. A number of these emanating from well known authorities are printed below:

(1) I believe in the use of electric locomotives rather than the equipment of the individual cars.

(2) I do not believe in the use of the three wire system for railways.

(3) I think the E. M. F. used should be not less than 200 volts per mile the power is transmitted.

(4) I believe the power should be produced and transmitted in the form of the alternating current, and that before being led to the moving contact it should be reduced to a pressure readily insulated, and then transformed upon the locomotive to a continuous current and used in this form in the propelling motors.

H. WARD LEONARD.

NEW YORK.

IN my opinion this work would naturally be begun by the placing upon the tracks, where it was desirable to do so, of self-propelled vehicles (motor cars), taking current from a trolley line above the tracks. This would enable frequent runs to be made between points at moderate distances apart, while it would not interfere with the use of the ordinary locomotives for the hauling of the usual trains. Such lines might come into use traversing only a portion of the existing railway with branches constructed for the passage of the electrically propelled vehicles to various points more or less remote from the existing line. In this way the railway companies might avail themselves of the advantages of the trolley and so constitute the trolley line branches as feeders for the main line, which latter may for some time to come preserve the character of a steam line.

Where, of course, a long train is to be drawn it may be desirable to use electric locomotives, particularly if the grades on the road are not great; or, perhaps, a compromise may be made in having one or more extra heavy motor cars at the head of a train controlled together and operated together, these motor cars taking the place of the locomotive itself, much as the motor car and trailer cars are used in the ordinary street railway traffic. I think that without doubt a potential of 1,000 volts would be feasible for use and that the line could be maintained without undue leakages or accident, since the conditions of the placing of the line would naturally be more within the control of the operating company than is now the case in street railways.

The overhead system of placing the conductors seems to me to commend itself as the best, except, perhaps, in cases like the elevated roads with an elevated roadbed, in the control of the operating company, in which cases it would make very little difference where the conductor was placed, either above or below, or on low standards alongside the road, the chief thing to be looked after being that a sufficient insulation is maintained. The absence of crossings makes it feasible to place the conductor almost anywhere where it is found desirable to have it.

I think that the three-wire system, using the track as the middle or neutral conductor would not necessarily be applicable in all cases, but would probably be desirable for certain types of double track roads, particularly if the balance of traffic could be maintained on the two sides of the system.

For the heavier railway work over long distances it appears probable that transforming systems must be employed, in which the energy is carried at potentials of 5,000 to 10,000 volts and distributed by machines converting down to sections of the trolley line or low pressure feeding conductor. It may be possible, in this case, to use alternating currents with advantage on account of the transformers being so readily installed and handled, while the motors themselves can, with such a system, be of low potential, easily protected from leakages, commutatorless, and directly carried on the driving axles, particularly where high speeds are to be attained. The means are now in existence for controlling the speed and obtaining variations of speed with high economy where several such motors are employed to drive a train.

ELIHU THOMSON.

LYNN, MASS.

CONCERNING the methods which it is desirable to adopt in changing over steam railroads to electric railroads, we are of opinion:

(1) That at the outset each car should be equipped with an individual motor or motors, rather than have an electric locomotive draw a train of cars as in the existing steam roads. We are led to this conclusion because each car being a separate motor unit, will at approximately the same expense, permit a greater number of cars to be run at more frequent intervals than is possible on a steam road, thus giving to the electric system the advantages now so clearly recognized as possessed by the individual trolley car; viz., short trains at frequent intervals, and consequently the commercial capability of stopping wherever passengers desire. It is probably this factor, as much as any other, which has caused the trolley system to be so popular.

(2) We would recommend that the limit of pressure employed on such lines with double track should be 1,000 volts, three wire, with ground return, that is, 500 volts on each track. Should it be found commercially desirable, later on, to raise the pressure to say 2,000 volts, this could probably be done without any change in the line construction.

(3) We would recommend that the conductor should be strung overhead, like existing trolley wires, at a sufficient distance above the road-bed to prevent accidental contacts. Placing the wires at any lower level would necessitate a change at grade crossings, as well as being more dangerous to life.

(4) We would recommend a single trolley wire over each track employing the rails as the neutral conductor. In order to do this, the rails should be thoroughly connected and bonded. Where the number of cars is small, and the length of the road great, so that a considerable distance might exist between adjacent cars on the up and down track, ground feeder wires would probably be essential.

At the outset, we would recommend broadly that it would be preferable to follow the present systems of trolley roads in the light of experience already gained, rather than attempt radical innovations.

HOUSTON AND KENNELLY.

LABORATORY OF HOUSTON AND KENNELLY,
PHILADELPHIA, PA.

TROLLEY EXPRESS IN NEWARK, N. J.

General Manager Young, of the Consolidated Traction Company, is authority for the statement that as soon as the new power house in Newark is completed the company will go into the express business. They have already received many requests from large manufacturers to build side tracks into their yards. Under their charter the company have a right to run these cars through the streets, and they will be run in the daytime as well as at night.

A NEW ELECTRIC RAILWAY FOR OHIO.

The Lorain & Wellington Railway Company has been incorporated at Columbus, Ohio, by H. G. Redington, E. M. Pierce, John Stang, I. Gilmore, J. W. Steel, O. F. Carter, and James Nicholas, Jr. Its general office will be in Lorain, and it will build a street railway between Lorain, Amherst, Oberlin, and Wellington, which will carry packages, mail, express and general freight, as well as passengers. It also has authority to sell electricity for light, heat, or power. The capital stock is $100,000.

COMPULSORY ADOPTION OF FENDERS IN BALTIMORE.

The Baltimore Grand Jury have presented General Managers James F. Heyward of the City and Suburban Railway Company, William A. House, Jr., of the Baltimore Traction Company, and Lawrence N. Frederich of the Lake Roland Line for violating the fender ordinance. The ordinance was adopted some months ago, and required that every rapid transit car or train be equipped with fenders before Jan. 15, this year. Only one line in the city complied with the law, but the others are now rushing the equipment work, as it appears to be the intention to punish the offenders.

THE cars of the Consolidated Traction Company crossing the Newark meadows are now equipped with storage batteries to guard against the extinguishing of the lights in case the trolley should leave the wire.

RECENT SPECIFICATIONS FOR ELECTRIC RAILWAY CONSTRUCTION.

We print below the specifications, for the track and line work of the Waukesha Beach Electric Railway, at Waukesha, Wis., prepared by Mr. Wm. Powrie, of Waukesha, chief engineer, and appearing in the *Engineering News*:—

The road is to consist of 5½ miles of single track, standard gauge, with three crossovers and double track sufficient for convenient switching. The overhead line is to be supported on the side-pole system, with curves, switches, etc. The feeder system is to maintain a maximum drop not to exceed 10% under full load. Cars, motors and other apparatus for the operation of the road, exclusive of the power-house equipment, are to be provided.

Ballasting and Leveling.—The road must be well ballasted with coarse gravel level with top of ties, 6 ins. deep underneath the ties, and brought to a grade, according to grade stakes furnished by the supervising engineer of the company. The track must be brought to alignement by tamping well under each and every tie, giving a solid foundation before any filling is done.

At cross-roads, or where village grades are established, they must be strictly adhered to, subject to the inspection and approval of the village engineer or inspector. At all curves the outer rail must be raised as specified in curve plan, so that the necessary high speed may be attainable with safety, and special care must be taken to have curves well tamped while ballasting or filling between the ties.

Wherever marsh or soft ground is encountered, a substructure of broken stone or other suitable material must be built, so that a safe and reliable foundation is furnished before the ties are tamped or any leveling is attempted. Special care must be exercised by the contractor in ballasting and leveling that a perfect alignement is secured.

Ties.—The ties, except those for switches and curves, must be of sound, white, clear cedar, with two well-leveled surfaces, not less than 7 ft. long, 7 ins. face and 6 ins. deep. They must be spaced 2 ft. c. to c., except at joints, where they must be not more than 6 ins. apart. At curves or crossovers the ties must be of white or burr oak, 8 ft. long, 6 ins. deep and 8 ins. face. These must be spaced 24 ins. c. to c. from the point of switch to a distance of 4 ft. from outer end of frog.

Ties must be free from rot, worm holes, splits or other imperfections affecting the strength or durability of the timber, must be subject to the inspection and approval of the supervising engineer of the company, and must be well tamped and firmly bedded with gravel, in order that each tie shall have a solid, unyielding foundation under it.

Rails.—The rails will be the Illinois Steel Co.'s 56-lb. standard T-rail, made of steel, with ends sawed square and smooth, and having a length of 30 ft. per rail. They must be free from flaws, honeycomb or blisters, and must be straight in all directions, free from twist of any kind. The rails shall be drilled for fishplates and bonds as per plan, and must be laid perfectly straight level and to gage. They must be fastened by two 5 × 9-16-in. iron spikes at each end of tie, so driven as to avoid splitting the tie.

Rail joints must be carefully made, and so adjusted that the rail ends are not closer together than 1-16 in., nor further than ¼ in. Fishplates must be of the standard pattern made for this particular rail and bolted up, using thoroughly reliable lock nuts; the same to be driven home with a hammer while the nut is being drawn up. This operation must be gone through twice on every joint. Special care is to be taken in laying curves, which must be placed accurately to plan, and spikes must be so driven that they will not draw, from strain on the rail. This work must be done subject to the most rigid inspection and approval of the supervising engineer, from whom all sights and centers can be obtained.

Special Work.—The special work shall consist of three turnouts, and such curves and switches as may be necessary to run cars into the car house, or at the terminals. This work must be done in a thoroughly reliable manner, and none but first-class workmanship will be accepted.

All switches, turnouts, crossovers, station tracks, terminal tracks, etc., must be built of the standard rail, and must correspond in character with the track specified for the general line, and as little cast iron used as is consistent with first-class construction. All surfaces subject to wear must be of steel. Switch tongues must be of standard length and size.

The gauge of the track shall be 4 ft. 8½ ins., and the gauge of turnouts, switches, etc., shall be so full as to insure the operation of motors and trucks easily at high speed.

Bonding.—At each joint the rail must be bonded by two 0000 B. & S. copper rail bonds of a length of 6½ ins. between centres. These bonds must be securely riveted into each side of the lower flange of the rail, the hole in rail to be countersunk from top side and to be brightened before the bond is driven in. The bond must have a solid shoulder against which to rivet. This work must be done in a careful and accurate manner, so that an absolutely perfect contact shall be obtained from the bond. Each bond and rivet head must after being placed be painted with a coating of black asphalt. The bonds must be so placed that the fishplates can be displaced without interfering with bonds.

Cattleguards.—Wherever, as shown upon the plans, by reason of farm and highway crossings, cattleguards or cattlepasses shall be required, the contractor shall furnish the same of the best standard make, together with ties of sufficient length for the proper placing of same.

Pole Line.—Side poles for span wire construction are to be used throughout, except in such places as it may be found impracticable to set a pole at each side of the roadway, in which case a pole with a single bracket arm is to be used. All poles shall consist of carefully-selected white cedar timber, straight and trimmed round. They must be not less than 7 ins. diameter at the top, which must be roofed or pointed. The height of pole shall be 20 ft. above the level of the track line, and each pole is to be set at least 6 ft. in solid ground.

Where filling has been done, poles must be of such length that they can be set to the full depth of 6 ft. in solid ground, as specified, and yet rise to a height of 20 ft. above the level of the track line. They must be placed not less than 100 ft. or more than 125 ft. apart, and there must be used at least 90 poles per mile.

Poles must be set in line, with a rake or inclination in opposite direction to strain of 18 ins. in 20 ft. The hole in which the pole is to be set must be dug as small as possible consistent with the proper placing of pole as specified, and the filling so well packed that the pole shall be able to withstand any ordinary strain on the span wire.

Where marshy ground is encountered, such provision must be made and material furnished as will secure a reliable setting for the pole. Cement or broken stone, if required by the supervising engineer, shall be requisite under this latter specification, and, if necessary, guy stays must be provided. All poles necessary for curves or anchor poles, must be set according to plan or direction of the supervising engineer. All poles shall be painted with one coat of lead color oil paint. Where bracket arms are to be used, a substantial wrought iron arm shall be furnished. A span wire of ¼-in. galvanized steel wire shall be stretched from pole to pole, with a ratchet at one end so that slack can be taken up readily. This ratchet shall be of the best and most approved make. The span wire to be drawn tight with a slight strain.

Trolley Line.—The trolley wire shall be No. 0 B. & S. hard-drawn copper, in lengths of not less than one mile, and must be supported on straight line hangers with either Medbery, Aetna or Johns insulation, using 15 in. soldered ears to support the wire. The overhead work on curves to be constructed in the most approved manner, using 9-in. slips with improved pull-offs for all spans.

All switches to be of the most improved plan and so adjusted as to allow the trolley wheel to follow accurately.

Strain pull-offs are to be placed at intervals not exceeding one mile, by which the line must be anchored in both directions. The ends of the line must be securely anchored through reliable strain insulators. Standard splicing ears must be used to connect the ends of the wires, and the joints must be well soldered. This work must withstand an insulation test of not less than one megohm per mile.

Feeders.—Provided the power house is placed at a distance not exceeding 2,000 ft. from the terminus of the line, two feeders are to be provided for carrying the current from the power house to the line. These must have weatherproof insulation and be placed on feed-wire insulators and supported by two pin-oak cross arms securely bolted to the side poles. There will be three feed wires of No. 0000 B. & S. gauge. One feed wire will be 10,000 ft. long and of an area of 0000 circular mils, and tap at the end through a feeder ear to the trolley wire. The second feeder must be 20,000 ft. long and of an area of 0000 circular mils, and the third 30,000 ft. long, tapped at the end through a feeder ear to the trolley wire. These feeders shall be put up in a substantial and reliable manner in accordance with the best electrical practice. All joints must be well soldered.

The feeders are to be protected by a water lightning arrester at the power house end, and no fewer than five non-arcing lightning arresters are to be placed along the line at intervals of one mile. These arresters must be securely fastened to the poles, and connected with No. 6 insulated wire from the rail for the ground connection and a No. 6 insulated wire from a feeder ear on the trolley wire for the current connection.

Cars.—The contractor shall furnish two closed motor cars, 25 ft. long in the body, 33 ft. long over all, and 7 ft. 10 ins. wide, with a seating capacity for 44 people, and an approximate weight of body of about 7,000 lbs. Also one closed motor car, 34 ft. long over all, and 7 ft. 4 ins. wide, with seating capacity for 44 persons, and weight of about 4,500 lbs. Also three open cars for use as trailers, having a width of 6 ft. 10 ins., a total length of 34 ft., and having twelve seats, with capacity for 60 persons, and weighing about 6,500 lbs. These cars are to be furnished with monitor roofs, full line ventilators, fare registers, mirrors, gongs, radial drawbars, ratchet brake handles, sand boxes, bumpers, commodious seats, etc., and shall be trimmed and finished in such style

and with such appurtenances, carpets and trimmings, as shall be required by the railway company. The painting and lettering of cars shall be as directed by the railway company.

Trucks.—There shall be furnished for each of the closed 25-ft. motor cars two pivotal trucks, with four wheels to each truck; the wheels to weigh not less than 300 lbs. each. The truck must be furnished with standard brakes, and with proper method of suspension motors. The wheels for said trucks to be 36 ins. diameter, and all four so connected as to receive uniformly the power transmitted to their axles from the motor. All wheels of said trucks to be of same size. Each truck shall be furnished with improved brake appliances and life guards.

For the 16-ft. closed motor car, a standard motor truck of some first-class reliable make shall be furnished, having a wheel base of at least 6 ft. 6 ins., provided with equalizing springs, lifeguards, adjustable brake system, journal boxes and all parts and adjustments in consonance with the best truck construction. For the three 34-ft. trail cars, pivotal four-wheel plain trucks shall be furnished, with proper springs, lifeguards and brake attachments, designed especially to secure easy riding and noiseless action.

Motors.—The motor cars shall be equipped with motors as follows: The two eight-wheel, double-truck motor cars shall be furnished with two 30 H. P. single-reduction motors, and the one four-wheeled motor car (closed) shall be furnished with two 15 H. P. single motors. These motors shall be furnished with all the equipment and appliances necessary and usual for a complete motor equipment and use upon a motor car, including controller, switches, lightning arresters, fuse box, light circuit, etc., and all must be of the best known material and standard make. The motors must be of the latest style, either of the General Electric Co. or the Westinghouse railway types, with single-reduction gearing, and guaranteed to give a speed with 36-in. wheels of 35 miles per hour when running to their full horse-power.

The controller must be that which is known as Type K, General Electric controller, or standard Westinghouse, and be of the latest improved form. All other apparatus, such as switches, trolleys, contacts, lightning arresters, etc., must be of standard make from the same company furnishing the motors.

Ten lights are to be placed on each motor car, two four-light clusters inside the car, placed on suitable fixtures, and one light on each platform, to be controlled on a five-light circuit by two snap switches. The trail cars must also have light fixtures the same as the motor cars, with connections so arranged as to take light from the motor cars.

Tests.—All work shall be regularly and systematically tested while in process of construction, and any defects found shall be immediately remedied. The final test shall be made in the presence of the supervising engineer or his representative, and the right is reserved by the railway company in case any doubt arises as to the fulfillment of the true spirit and intent of these specifications, to demand a test by expert engineers selected as is usual in matters of arbitration, whose decision shall be final on all disputed points, the expense of such tests to be borne equally by both parties, unless the apparatus or material shall prove defective, in which case the contractor shall bear the expense and shall also remedy the defects, and he shall also be liable for any damage or loss to the said railway company resulting from conditions incident to the remedying of such defects.

During the progress of the work, it shall be subject to the inspection of the supervising engineer or of his representative. The railway company will assume no liability nor responsibility for any part of the installation until formally accepted in writing, and no part will be accepted until the company is satisfied that it fully complied with the spirit and intent of the specifications. The acceptance of any portion of the work shall not be construed as a final acceptance, and the failure of any part to perform its proper function shall be sufficient grounds for the rejection of the whole.

The final acceptance shall be given only after the completion of the work contemplated under the specifications according to their true spirit and intent, and after the final test as specified. Such acceptance, however, shall not prejudice any claim which the railway company may have for the replacement of defective material for the time specified. The date of the completion of the final test shall be taken as the date of such final acceptance, provided such test proves satisfactory.

MOTOR CARS FOR THE METROPOLITAN ELEVATED RAILROAD, CHICAGO.[1]

The electric motor cars now being built by the Barney & Smith Car Co., of Datyon, O., for the Metropolitan, West Side

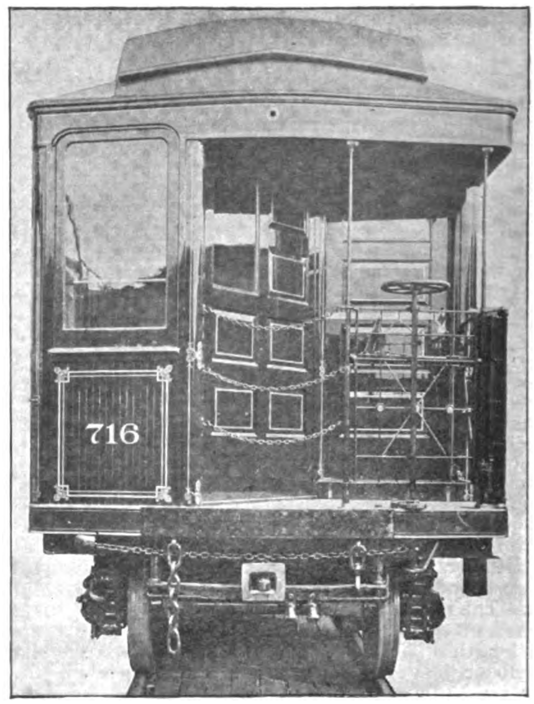


Fig. 1.—Chicago Metropolitan Elevated Motor Car.

Elevated Railroad Company, of Chicago, differ in many respects from the customary practice in car building. The salient feature of the car is the steel sub-frame, which it was thought necessary to add to enable the car to pull six loaded, 40-foot trailers, and also to get sufficient weight for traction; for the latter reason no attempt has been made to lighten the construction of the car body and trucks.

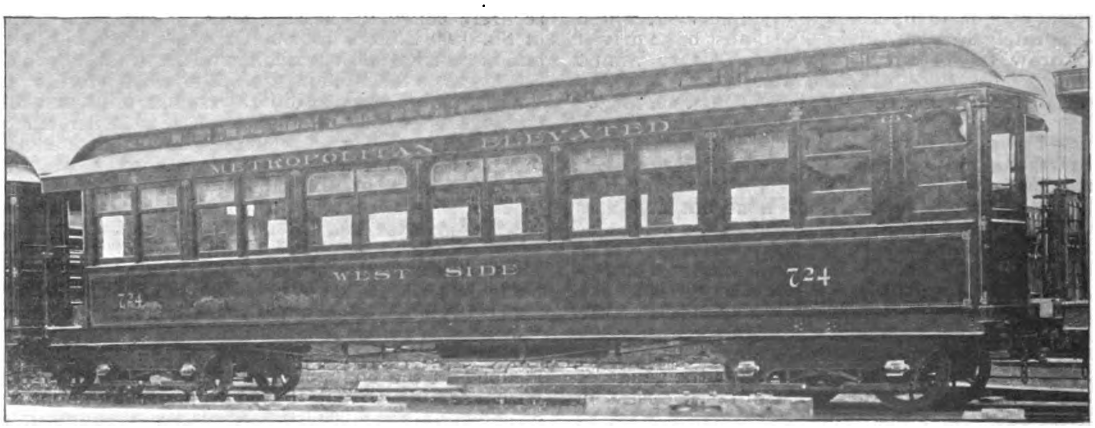


Fig. 2.—Chicago Metropolitan Elevated Motor Car.

1. *The Railroad Gazette.*

The weight of this car, exclusive of all electric apparatus, is nearly 40,000 lbs., the length of the body is 40 ft.; the length of the steel sub-frame, including the oak end sills is 47' 3"; the width at sill line is 8' 7", and at the eaves 8' 11"; the height from rail to top of roof is 12' 10".

The car is constructed in the usual manner, with oak end sills, and six longitudinal, long-leaf, yellow pine sills and stringers. The end frames are provided with iron plates at sill, plate and uprights to prevent telescoping in case of collision. The motorman's cabs, of which there are two, are in diagonally opposite corners, and are built out on the platform as far as the hood will permit. This construction necessitates the location of the en-

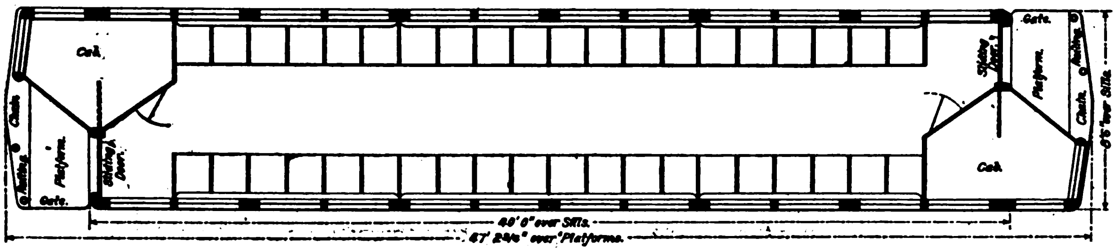


FIG. 3.—PLAN OF MOTOR CAR—METROPOLITAN ELEVATED RAILROAD OF CHICAGO.

trance doors next to the corner posts, and as it was thought desirable to have them of the sliding type; they are pushed back into the cab, which, however, does not interfere with the motorman, as the front door is always locked.

The exterior is sheathed with narrow beaded poplar in the usual manner, painted a dark brown shade, with handsome decorations in gold leaf. The platform railings and gates are of the usual elevated car type.

The interior of the car, with the only exception of the window blinds, which are linwood, is finished in quarter sawed oak, with a liberal amount of carving, thoroughly varnished, hand rubbed and polished. The seats are arranged at the sides and covered with rattan.

The cars are to be electrically lighted with an ample number of incandescent lamps, which are placed at the bottom edge of the lower deck ceiling so as to be directly above the seats. The warming in winter will be provided for by a number of electric heaters so arranged in series that the temperature can be kept up to the proper degree.

The steel sub-frames are constructed with two 9-in. I-beams, immediately under the side sill of the body. They are connected at the ends by 9-in. channels, to which oak buffer timbers are attached. A $\frac{5}{16}$-in. stiffening plate secured by rivets to the end channels and I-beams extends across the frame end, under the end-sill of the car body. This also forms the foundation for the platform floor. The body bolsters are part of this sub-frame. They are box-shaped, being built up with 9-in. channels, and ½-in. plates. Corresponding in location to the needle beams of ordinary cars are 6-in. I-beams, placed flush with the top edge of the frame. All cross members are coped where they meet the 9-in. I-beams, and are secured to these with proper connection angles. The sub-frame is supported horizontally by a pair of 1¼-in. truss rods, which are anchored to the bolsters, and pass under substantial queen posts attached to the frame at the intersection of needle beams and side beams.

The couplers are attached to forged brackets secured to heavy radiating bars, which are located immediately underneath the $\frac{5}{16}$-in. stiffening plate above mentioned. One end of these radiating bars passes through a slot provided in the bolster and engages with a turned king bolt, and the other end is carried by a 4-in. I-beam, extending across the frame for this purpose. The arrangement is, perhaps, not the strongest, but as the space underneath is limited, owing to the presence of the electric motors, it is probably the best under the circumstances.

The trucks on which these cars are mounted are a departure from the usual practice. They are somewhat on the lines of an engine truck, and equal to it in workmanship, but better provided with springs. It is difficult to describe this truck in the absence of working drawings.

These cars are equipped with quick-action air brake apparatus. The required compressed air is carried in a storage tank, provided under each car, which tanks will be charged from a conveniently located plant.

NEW ELECTRIC ROAD OPENED.—The new Chicago avenue trolley line in Cicero, Ill., was opened for traffic on the 20th inst. It extends from West 48th and Lake streets north to Chicago avenue and from there west on the latter street to Harlem avenue. The total distance is nearly three miles. Cars will run every 15 minutes until February 1st, next, when more cars will be put on. The road will act as an additional feeder to the Lake street "L" road and the Madison street cable lines.

TELEPHONY.

TELEPHONE NOTES.

TOLEDO, O.—A new telephone ordinance has been introduced which will give Toledo the advantages of a conduit system on business streets.

SPRINGFIELD, MASS.—The New England Telephone Company will make some important improvements this spring, which will considerably better the service between Springfield, Boston and Pittsfield. A new copper circuit will be put in between Springfield city and Lee, and the towns that will be directly benefited by the new circuit will be Pittsfield, Lenox, Stockbridge, Dalton and Great Barrington. A new line will also be put in from Springfield to Boston.

THE ERIE TELEGRAPH & TELEPHONE CO. made a gain in its territory of 79 subscribers for December, 284 in the three months and 672 for the year. The total number connected on Jan. 1 was 16,085.

UPPER SANDUSKY, O.—At a meeting of the council that body granted the Phœnix Telephone Company franchise, which permits them to erect and operate a telephone system in this place. The rates are to be $2 for business and $1 per month for residences.

THE GILLILAND TELEPHONE CO., Chicago, report the closing of a good number of contracts recently for private line and exchange equipments. Mr. Nate, their manager, is preparing a neat catalogue illustrating and describing the telephones and other appliances handled by the company.

CLARKSVILLE, TENN.—Capt. F. P. Gracey, Hon. D. N. Kennedy, M. Savage, B. H. Owen, R. H. Burney and James Bowling, leading business men, have formed the Clarksville Telephone Company, and propose furnishing a service for Clarksville at $12 per year cheaper than the East Tennessee Telephone Company which now occupies this field.

LUBEC, ME.—An act to incorporate the Harrison Telephone Co. of Lubec, was presented by Mr. Lawrence, of Lubec. Henry S. Kelley, Eben H. Bennett, Jesse Lurchin and Walter B. Mowry are named as the incorporators. The route is from some point in the town of Lubec, through the towns of Prescott and Whiting to some point in the town of East Machias. The capital stock shall not exceed $50,000.

HAMILTON, O.—The new telephone company recently organized and composed of Willes E. Hall, G. P. Stevenson and others, has sold its franchise recently granted by Council to a new company. The present company will at once commence work on constructing the lines, etc. The officers of the company are: Joseph B. Hughes, president; Colonel F. W. Whitaker, vice-president; Thomas Boyd, secretary; and F. S. Heath, treasurer.

ORIENT, L. I.—The Orient and New York Telephone Company has begun building its lines. It will extend from Orient to Riverhead, from Riverhead to Wading River, from Wading River to Oyster Bay, and then on to New York, taking in all villages on its route. The stock is taken up all along the route of the line. The president is James A. Gildersleeve, of Mattituck; secretary, John A. Bagshaw, of Riverhead; treasurer, O. B. Goldsmith, of Cutchogue.

CINCINNATI, O.—The Tri-state Telephone and Telegraph Company has been incorporated for the purpose of constructing telephone and telegraph lines and carrying on a general telephone, telegraph and messenger business and service in Ohio, Indiana and Kentucky. The articles provide for construction and operation of lines in each county of Ohio, Indiana and Kentucky The termini in Ohio are to be Steubenville, Cleveland, Toledo Columbus and Cincinnati. Indiana termini are Elkhart, Indianapolis, Terre Haute, La Fayette, Vincennes and Jefferson City. Kentucky termini are Frankfort, Louisville, Covington, Catlettsburgh and Pineville. The capital stock is $250,000 and incorporators M. S. Fisher, William S. P. Oscamp, Michael Ryan and P. R. Budd.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIX. NEW YORK, FEBRUARY 13, 1895. No. 354.

CONTENTS.

FIRES AND FIRE UNDERWRITERS.

THE statistics of fires in New York for 1894 are of more than ordinary in interest as they show, that in spite of adverse circumstances, the losses by electricity are greatly on the decline.

The fires for the year 1894 from the various causes were as follows :

Kerosene Oil..........	347
Gas..........	230
Matches..........	278
Electric Light & Power..........	48
General..........	2150

The number of general fires includes all fire alarms, a certain number of which are false alarms, but as they are recorded as fires in the official reports, the number is therefore stated as 2150. A comparison with the report which we published last year of all fires from the above causes, from 1888 to 1893 inclusive, shows an increase from all causes, electricity as well as the others. But if a comparison be made as to the relative loss by fires from electricity, and those caused by kerosene oil or gas, an entirely different aspect is placed upon the matter from that which a casual glance at statistical figures alone would indicate. For instance, the number of fires for the year 1894, caused by electricity, with the exception of the central station fire of the United Electric Light & Power Company, did not incur a money loss or waste of $500; whereas the money loss or waste from kerosene oil fires alone, it is safe to state, amounted to over a million dollars.

In connection with the fires by electricity, it may be pointed out that quite a number of the 48 fires were caused from defectively installed arc light apparatus, and this brings us directly to the question, whether the defective arc light apparatus would ever have been installed as it was, if it had not been for the inconsistent rules of the New York Board of Fire Underwriters, which compel the electric light companies to operate apparatus contrary to well known rules in regard to positions and maintenance. It seems hardly fair therefore, to throw the responsibility for these fires upon the electric companies when they are acting—practically under protest—in accordance with the rules of the New York Board of Underwriters. We may therefore justly claim that if the New York Board of Fire Underwriters had employed reliable inspectors, and consulted with the illuminating companies in regard to methods of procedure and maintenance for electric light equipments, the number of fires for 1894 would have been far less than they were.

The insurance people when they point to the increased number of fires, caused by electricity, for the past year, should go slow in laying the blame for the increase, at the door of electricity. Indeed, we venture to assert that they themselves more than anyone else, are to blame for practically all poor installations in New York City, as all electrical work has been installed under their own exclusive supervision up to the present time. Considering that large insured interests have recently been compelled to expend large sums of money in re-arranging their equipments, which they supposed were in good condition, as certified to by the N. Y. Board, they have shown wonderful forbearance in demanding their rights in the case. In fact there is no satisfactory explanation of the inconsistent actions of the various insurance interests. Indeed, for the past twelve months users of electric light and power have been in a most embarrassing position, owing to the action of the various insurance interests, as represented by the Board of Fire Underwriters, the Bureau of Inspection, and other individual inspections made by the insurance companies. Take a typical case : On more than one occasion inspectors from one interest have certified that everything

was in accordance with the standard rules; an inspector from another interest would deny this, and a third inspector would state that it was unsafe from another standpoint; and in the meantime notices would be sent out of cancellation of policies. The N. Y. Board of Underwriters would then claim that the notices amounted to nothing, that the assured had his certificate and therefore the work must be safe or the certificate would not be in existence. The assured would then refer the matter to the insurance broker, and, after being knocked about from pillar to post, would finally ascertain that his installation was a long way from being safe, the question of standard not being referred to, in a great many cases. Then when the installation had been placed in good condition, although not up to the present standard, the Underwriters, who had originally stated that it was safe, would now, after it really was safe, declare it to be unsafe! This is not a fanciful record but one of actual fact, incredible as it may appear.

There seems to be no opportunity for the illuminating companies, or the assured, to know from one day to another, what action the Underwriters propose to take through their various inspection departments. It is notorious that there is great lack of uniformity in making surveys in accordance with what is supposed to be a standard set of rules. Is it any wonder then that there should be a trifling increase of fire from electricity? As a matter of fact, it is our opinion that, considering the present condition of affairs, if the surveys were left strictly in the hands of the responsible illuminating companies, the insurance interests would be as fully protected as they are at present through the N. Y. Board of Fire Underwriters. In proof of this we need only point to some of the finest buildings in this city, that have recently been installed, under strict supervision (supposedly) of the Board of Underwriters; and now that these installations are complete, large amounts of money are being spent in the attempt to re-arrange the equipments, to bring them up to a point where they can be used with economy and safety! There can be little doubt that almost the entire responsibility for the imperfect installations rests with the insurance interests. Let them stop their internecine strife, and get their house in order. Inspection has been and always will be necessary, but an end ought to be put to the opera bouffe methods now prevalent in New York.

THE PASSING OF THE HYDRAULIC ELEVATOR.

The history of the mechanical progress of the world has demonstrated that as improved and more economical methods of generating and distributing power have become available the older methods in use have gradually narrowed in their sphere. Electricity against steam as a motive power had to encounter perhaps greater barriers than steam did with animal power. In the case of the street car, the victory over the horse was a comparatively easy one as has always been the case where mechanical power has been substituted for animal power, but electricity still has a struggle before it to displace not a few applications which time has strongly entrenched. Among these we may mention the elevator service in the enormous office buildings which are now being erected in every city. For ordinary buildings of a few stories in height, many hundreds of electric elevators have already proved their value, and some idea of the extent of this work may be gathered from the statement that in New York city alone there are connected to the Edison service mains no fewer than 250 elevators, aggregating 3,000 horse power. This class of electric elevator service presented no particular difficulties in the past, but the high duty service requisite in buildings ranging anywhere between 10 and 25 stories presented a problem which even the boldest of electrical engineers have shrunk from attempting until within quite a recent period. Indeed, it took the courage of conviction and the electrical skill of Mr. Frank J. Sprague, aided by the mechanical ingenuity of Mr. Chas. R. Pratt, to bring the electric elevator to a point where it could successfully compete with the high duty hydraulic elevator. We have from time to time noted the installation of these elevators, but the announcement which we make in this issue of the entire equipment of the great Parrot Building, San Francisco, with no fewer than 15 Sprague-Pratt elevators, must be considered conclusive evidence of the fact that the electric elevator has come to be recognized as the standard high duty elevator of the world. The continued experience with the Sprague-Pratt elevators in the Postal Telegraph Building in New York more than confirms the estimate put upon them and while we do not suppose that hydraulic elevator building will cease at once, we are convinced that the days of the hydraulic elevator as the standard are numbered. While the experience of the Postal-Telegraph Building and of other buildings with other types, has already proved the economy of such elevator service, it might be well to emphasize the fact, or point, that an ideal condition of affairs could be realized in electric elevator service by the introduction of storage batteries. The service, being highly intermittent in character, presents the best conditions for economical working in connection with storage. But there is another immense superiority over the hydraulic elevator. In the case of the latter, the storage tank, under the best conditions, would probably be able to afford scarcely half a dozen trips after the shutting down of the pumps, whereas a storage battery, occupying the same space as the water tank of the hydraulic elevator, would store perhaps twenty times the energy contained in the stored water, or, in other words, allow of over a hundred elevator trips. Besides this, there would be an additional advantage in the decreased size and cost of the steam and electric plant, due to its operating at maximum power at all times, independent of the elevator load. Besides the introduction of the electric elevator into public buildings, we may also look for a large increase in the number of those installed in private dwellings, a field which ought by no means to be neglected by central stations desiring to sell current and to maintain a uniform load.

THE CLEVELAND CONVENTION.

The indications are already numerous that the Cleveland convention will be largely attended and that the work will be interesting and valuable. We publish the full programme on another page; and Mr. Porter advises us that the attendance promises to be very good. It is a pity that the annual meeting is held at such an inclement season of the year, when the beautiful cities of the Lake region are at their worst; but we know that the reception in Cleveland, mother city of the arc lighting art and industry, will be cordial and enthusiastic. Cleveland remains to-day, after many vicissitudes of the electric lighting business, a prominent centre in its affairs, where at any time there is much to learn, and where during convention the opportunities for increasing one's store of information will be specially numerous. It is to us a feature of good augury that the president of the local committee is Mr. C. W. Wason, well known as a leading electric railway manager and engineer, and president of the admirable Cleveland Electric Club. Mr. Wason's position exemplifies the close relation that should and must exist between the two greatest branches of electrical engineering; and he and his associates have been active in their efforts to provide a warm welcome for us all next week.

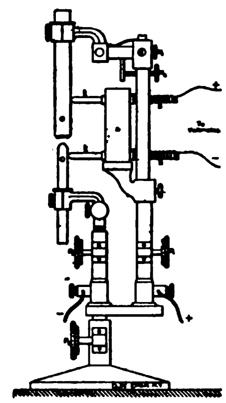
MISCELLANEOUS.

THE ELECTRIC ARC.[1]—I.

BY HERTHA AYRTON.

At the Electrical Congress held in Chicago in August, 1893, Prof. Ayrton read a long Paper on this subject, which gave the results of experiments which he had been carrying out with his students during the three preceding years. Neither the Paper, however, nor even any abstract of it has been hitherto published, since, while it was in the hands of the secretary of Section B of the Congress, it was unfortunately burnt five months after it had been read.

Prof. Ayrton, having no rough copy, had neither the courage nor the inclination to rewrite the Paper, which had already cost him so much trouble; but, as my own interest in electric arcs was roused while I was helping him in some of the later experiments, and as the investigations which I am at present carrying on are a continuation of those which he made, it will be well, before dealing with the results which I have since obtained, to give a very short abstract of the most important points, which he noticed and the deductions made from them. This, fortunately, I am able to do, by using the curves which, having escaped the sad fate of the Paper itself, have been returned to him from America, and by examining the laboratory note-books.



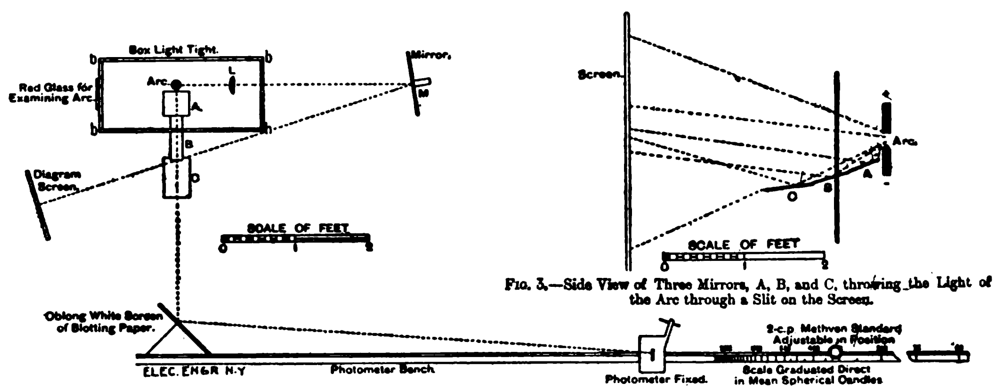


FIG. 3.—Side View of Three Mirrors, A, B, and C, throwing the Light of the Arc through a Slit on the Screen.

FIG. 1.—HAND FED ARC LAMP. FIGS. 2 AND 3.—GENERAL PLAN OF APPARATUS FOR TAKING MEAN SPHERICAL CANDLE-POWER OF ARC. A B C, THREE MIRRORS AT DIFFERENT ANGLES; L, PROJECTING LENS; M, MIRROR; PHOTOMETER BAR ABOUT 12 FEET LONG.

The experiments to which Prof. Ayrton specially directed his attention were briefly:—

1. Obtaining curves connecting the steady final values of the potential difference between the carbons with the current for different currents, lengths of arc, and sizes of carbons, cored and uncored.

2. Obtaining the time variations of the potential difference between the carbons with various constant currents, various constant lengths of arc, and with the ends of the carbons variously shaped.

3. Obtaining the time variation of the potential difference between the carbons when the current was suddenly changed, and the length of the arc was kept constant.

4. The distribution of potential throughout the arc.

5. The influence of varying the current and the length of the arc on the depth and width of the crater.

6. The candle-power and efficiency of the arc, with various currents, potential differences, and lengths of arc.

The lamp (Fig. 1), was hand-regulated, the adjustments being effected by turning pinion P_1 to alter the height of the positive carbon, P_2 the height of the negative carbon, and P_3 to raise both carbons together. By turning the nut N_1 the positive carbon could be turned about a horizontal axis in the plane of the figure, and by turning the nut N_2 the positive carbon was moved round a horizontal axis at right angles to the plane of the figure. To measure the potential difference between the tips of the carbons, the voltmeter was attached to two thin carbon rods *k k*, sliding in tubes in a block of asbestos, A, and pushed against the main carbon rods C C by spiral springs S, S. Had the potential difference been measured between the lamp terminals, a variable error would have been introduced, from the drop of pressure in the carbons themselves, which would have been serious with large currents and long carbons. And, since the voltmeter had a resistance of about 80,000 ohms in circuit with it, the resistance between the ends of these auxiliary voltmeter carbons *k k* and the main carbons C C introduced no practical error.

The length of the arc means throughout the vertical distance between the point of the negative carbon and the horizontal plane drawn through the edge of the crater of the positive, this distance being measured on an image formed on the diagram screen at the upper left-hand corner of Fig. 2 by the lens L and the plane mirror M. This image of the arc was exactly ten times full size. Length of arc "0 millimetres" does not, therefore, mean that the carbons were in contact, but that the point of the negative carbon was just entering the crater at the end of the positive carbon.

Figs. 2 and 3 indicate the general optical arrangements that were employed for measuring the light given out by the arc under different circumstances, to be described later on. In each of these two figures, A, B, C are three plane mirrors so placed as to reflect on to the screen that portion of the light which would otherwise have passed under the screen.

In Figs. 4, 5, and 6, the curves connect potential difference between the carbons with the current flowing for various constant lengths of arc, and with various sizes of carbons. Each point on each curve represents the potential difference between the carbons *after* the current has been kept flowing at its specified value for a considerable time, and the length of the arc kept at its specified value during the *whole* of this time. The carbons have thus acquired their normal shape for the particular current and length of arc. The time required for this varies from about 10 minutes to over one hour under different circumstances, and want of appreciation of the very long time that it is necessary in certain cases to keep the current and length of arc constant before the carbons acquire their final shape led to much labor being wasted at the commencement of the investigation in obtaining looped curves for ascending and descending current, like hysteresis curves for iron.

In 1879 the late Mr. Schwendler published the then new fact that the potential difference between the carbons for a fixed length of arc was independent of the current. This result was confirmed by Profs. Ayrton and Perry, for currents that were fairly large for the carbons employed and for the length of arc (*Proc.* Phy. Soc., 1882, Vol. V. p. 197). More recent experiments, however, carried out with a greater range of current, have shown that the potential difference generally falls with increase of current for a constant length of arc. The curves on Figs. 4, 5, and 6 show that when the positive carbon is cored it is only for *long* arcs that this latter result is true, but that for short silent

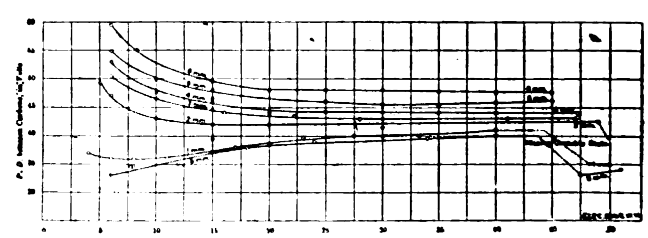


FIG. 4.—P. D. AND CURRENT FOR DIFFERENT LENGTHS OF ARC. CARBONS:—POSITIVE, 18 MM., CORED; NEGATIVE, 15 MM., SOLID.

arcs the potential difference actually rises with increase of current—a fact not previously published. Between these descending curves for long silent arcs and ascending curves for very short silent arcs there is a region in which the potential difference is practically independent of the current after the current has reached a certain minimum value; that is to say, it is for arcs of about this one length for each particular pair of carbons that Mr. Schwendler's result is true.

The particular length of a silent arc for which the potential difference is practically independent of the current is a little under two millimetres. When *both* the positive and negative

1. Abstract from the London *Electrician*.

carbons are *cored* the point at which the curves connecting potential difference and length of arc for different currents cut one another becomes very marked, and the length of arc corresponding with this intersecting point diminishes to three-quarters of a millimetre. On the other hand, when *both* carbons are *solid* there is *no* length of silent arc, for which the potential difference is independent of the current.

For very small currents, however, whether one, or both, or neither of the carbons be cored, the potential difference falls rapidly with increase of current, probably on account of a small current arc presenting a large cooling surface in proportion to its cross-section.

On examining the curves in Figs. 4, 5, and 6 another very curious fact may be noticed, viz., *if the potential difference between the carbons be kept constant, and the arc be lengthened, and maintained at the greater length, the current is larger and not smaller than it was for the shorter length of arc.* For example, a given potential difference, say 50 volts, sends a current of 4.1 amperes through an arc two millimetres long (Fig. 5), 6.2 amperes through an arc three millimetres long, 9.6 through one of four millimetres, and 16.4 amperes through one of five millimetres, all the arcs being silent. Or, dividing this potential difference of 50 volts by these currents, it follows that the apparent resistance of the 2, 3, 4, and 5-millimetre arcs for this potential difference are 12.2, 8.1, 5.2 and three ohms, respectively. Hence for a *constant potential difference, the apparent resistance of the silent arc, when in the normal condition, diminishes rapidly as the arc is lengthened.* I shall have to refer to this result again when describing my own experiments.

Another interesting point that is seen from the curves Figs. 5 and 6 is that for very short silent arcs any given potential difference will send two distinct currents through the arc; for example, a potential difference of 41 volts (Fig. 5) will send either a current of 3 or of 21 amperes through a 1 millimetre arc. This points to the complete equation connecting potential difference, current, and length of arc for silent arcs, produced with a cored positive and a solid negative carbon, being a quadratic in terms of C, the current flowing, and not a linear equation such as has been published. To this I shall refer again, but I may mention that I do not find that such an equation as

$$v = a + b\frac{l}{C},$$

where v is the potential difference between the carbons, a and b constants, l the length of the arc and C the current (Prof. Silvanus Thompson, *The Electrician*, August 26, 1892) satisfies the curves on Figs. 4, 5, and 6, even for the longer arcs.

The part in the curves marked "Hissing Unstable State" really indicates a condition of the arc such that no current between the highest for the silent arc and the lowest for the hissing can be sent through the arc at all. For instance, on Fig. 6, consider the curve for a 3 millimetre arc. It is there indicated that no current between 17.5 and 21 amperes will pass through the arc. If, when a current of 17.5 amperes is flowing, you lower the resistance in the circuit by ever so little, the current immediately leaps up to 21 amperes or thereabout, and the potential difference falls from about 46 volts to about 37.5 volts, and, however cautiously and slowly you diminish or increase the resistance, the same result

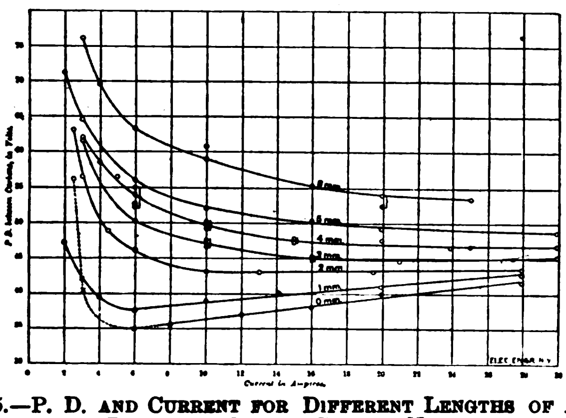


FIG. 5.—P. D. AND CURRENT FOR DIFFERENT LENGTHS OF ARC. CARBONS:—POSITIVE, 18 MM., CORED; NEGATIVE, 11 MM., SOLID.

will follow, you will have either a silent arc with about 17½ or a hissing arc with about 21 amperes.

The potential difference for hissing arcs increases with length of arc, but appears to be fairly constant for a given length of arc (Fig. 6); in other words, the total apparent resistance of the hissing arc varies nearly inversely as the current for a given length of arc.

One talks of hissing, however, as if there were only one sort of hissing, whereas really there are at least two, with very different significations:—(1) The sort of sound like a kettle just about to boil, which belongs to a long arc with a small current, but which is *not* accompanied by a drop in the potential difference. (2) The sharp hiss of an arc of any length when the current sent through it is too great for a silent arc to be maintained; this is the hissing usually referred to. There is a third sound, rather like the wind blowing through a crack, which comes just before the hissing with big currents begins. It is a sound very difficult to maintain, for the arc has a great tendency at that particular stage to become either hissing or silent; it is accompanied by a beautiful intense pale green light along the edge of the positive carbon, or, rather,

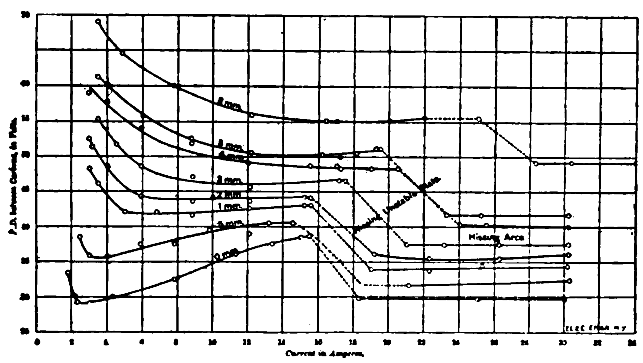


FIG. 6.—P. D. AND CURRENT FOR DIFFERENT LENGTHS OF ARC. CARBONS:—POSITIVE, 9 MM., CORED; NEGATIVE, 8 MM., SOLID.

probably coming from the crater itself, but seen just above the edge of the crater in the image on the screen. There are also several other sounds given out by the arc, generally of a temporary character, and very difficult to classify.

There seems to be some idea that a "hissing arc" proper is necessarily a short arc, an idea which the curves in Fig. 6 will immediately dispel. Hissing may occur with any length of arc, if the current be increased beyond what the arc can bear silently. The hissing obtained with an 8 millimetre arc and a current of 29 amperes, for instance, is of exactly the same character as that obtained with a current of some 5 or 6 amperes when the carbons are first separated to form the arc. In both cases it simply means that the current is too big for the arc to burn silently.

ELECTRICAL EDUCATION.

BY

Edgar Kidwell

I have lately read in your columns "Some Aspects of Electrical Education," by Prof. W. M. Stine, of Armour Institute. This article presents some statements and views which are liable to mislead those not posted on the present state of technical education; I purpose, therefore, to discuss it, and what I wish to show is: (1) There is in it entirely too much matter irrelevant to the subject; (2) The educational views are not sound, and some of the statements are not founded on facts; (3) The views regarding an engineer's duty and qualifications are not in conformity with the demands of actual practice.

There is a certain gentleman highly renowned for his readiness in finding something for idle hands to do, and it is the belief of no small portion of the engineering profession that this gentleman has a special preference for college professors; indeed a casual review of many of the transactions, etc., of Engineering Societies will convince one that such belief is not totally unfounded, when he finishes wading through long winded deductions and discussions of useless formulas for chimney draft, chimney diameters-effect of clearance on toy engines, and other such matters too numerous to mention. In this busy age one of the greatest desiderata is economy of time and effort. Most engineers have far too little time for private study, and it is all important that he who writes for them bear that fact in mind, drop all useless attempts at flowery language, stick close to the subject, present clearly and accurately the matter under discussion, go straight to the point, and not waste the reader's time, or distract his attention, by lugging in illustrations, comparisons, etc., which show nothing, and only befog the understanding of many. Engines and rhetoric have no connection that I know of, nor has electrical engineering anything to do with party lines, grafting on shoots, pendulum oscillations, brain friction, or anything of the sort. Such matter is entirely irrelevant to the subject, and should have been omitted. Two thousand years ago Horace advised writers "to plunge right into the middle of the subject." This advice is just as sound to-day as it was then, and ought especially to be followed by men who, by reason of their

position as educators, are supposed to be better able than the majority of individuals to express their ideas precisely and clearly. It is to be regretted that many men, and not a few of them professors, seem to take the opposite view, and it is due in no small measure to such men that "a prejudice should have thus originated against the fundamental knowledge of certain sciences and mathematics, etc." It has been my experience that nearly every man is ready and anxious to listen and learn, if matters are properly presented to him, but he will not endure the Widow Bedott style of narration, even if it is perpetuated by an eminent scientist.

To touch on some of the educational views. "The difficulty with our schools has largely been lack of acquaintance with, and appreciation of, the practical applications of electricity, on the part of the instructors. As a consequence, courses have been too vague in general." Let us examine these broad statements. "By their fruits you shall know them" applies to technical courses as well as to anything else. The great strides made in all engineering, and particularly in electrical engineering, during the past decade or two, are due in great measure to our technical schools, Previous to that time, most engineers had to get their knowledge as Sir Frederick Bramwell says he got his. "When I was a lad, I was apprenticed to a master who taught me all he could teach me. He taught me what has been very useful, viz., a great deal of practical work. He did not teach me much theory. He had not got it to teach. And as he did not have it, his sphere was limited, and he was compelled to fall back on precedent, when a new and unexpected problem presented itself." [1] The technical school supplies men, who, while not engineerers on the day they graduated, were thoroughly versed in those immutable laws of nature which form the basis for *all* engineering. It is true that they had further to acquire much practical knowledge, but they *did* acquire it, and when they applied it they struck out into new and unexplored lines, and the result is engineering as we find it to-day. From these results let our engineering courses be judged. Like all human things, they were formerly, and are yet, capable of great improvement, but that they were "too vague and general," or that those who had charge of them were in a great measure lacking in "acquaintance with, and appreciation of, the practical applications of electricity," seems to me to be a mere gratuitous assertion, lacking in basis of fact.

"In the perfectly organized school, not only the requisite mechanical engineering, but the chemistry, physics, and mathematics as well should be taught by men who themselves have first been trained for the electrical engineering profession, and subsequently specialized in their respective branches. They would then be well qualified to decide to what extent their subject should be presented, and what particular phases most elaborated." At first sight, this plan appears to be good, but on close examination, two faults appear, viz., (1) it is impracticable except perhaps in rare cases; and (2) even if adopted, it will give results no better than can be got by the usual method. For the first statement. Except those who by reason of relationship or wealth are certain beforehand of coming into an already established business or professional practice, but few students know with any definiteness exactly what they are to do when they leave school. Circumstances entirely beyond our control often put us where we least expect, and deny us the particular kind of work we most desire. It will be rare, therefore, that anyone could afford the time and money requisite for getting an engineering education, and afterward pursue such a course in mathematics, physics, etc., as would qualify him to become a professor in these branches. Even if he did all this, his chance of getting a chair congenial to him, and worth the trouble he had spent in preparing for it, would be very slim. Few men would take the risk.

As to the second objection. This view of making professors of mathematics, physics, etc., out of quondam electrical engineers is a reflex of the old and long-ago exploded notion that every man, regardless of his station in life, ought to learn a trade, thereby preparing for self-support in case of financial disaster. Suppose he learned the trade well, of what earthly use would he be at it, if he took it up again, after paying no attention to it for years? Materials, methods, machines, etc., would all be so new to him that he would be practically useless as a mechanic? Prof. Stine says advancement in electrical matters is rapid. So it is, and when our hypothetical professor of mathematics, chemistry, etc., finally secures a job, his knowledge of the then existing electrical science and practice would be behind the times. No man could keep up fully with both branches, hence the seeming advantage of the plan disappears. If a man started ten or twelve years ago to study electrical engineering, then later took up mathematics as his specialty, he *might* perhaps be ready at the present date for a professorship in mathematics. But a moment's consideration will show that since his studies in electrical engineering were made, the alternating system with its numerous applications has come in, and it is this particular branch of electrical engineering science which requires the greatest application of mathematics. Unless our professor has kept up his electrical engineering studies when preparing for his other branches, which is hardly possible, he would know nothing of such work, and would be no better off than any other good mathematician who has not studied electrical engineering at all. What is more to the point, I have seen this very plan tried, but the expected advantages and successes did not materialize.

But how can the proper teaching be done? I shall try to answer this briefly, and at the same time dispose of "veritable Shylocks, determined to have their pound of mathematics, or chemistry," which individual, so far as my experience goes, does not exist to the extent Prof. Stine imagines.

The professor of electrical engineering should draw up for the guidance of the professors of mathematics, physics, etc., a full synopsis of the work to be done by them to prepare the student for the course in the electrical department, and this synopsis should from time to time be revised as the scope of the electrical work is broadened. In schools teaching various branches of engineering, the professor directing each course should draw up a similar synopsis. The professor in charge of the preparatory work, mathematics, for example, can then lay out a course embracing all the work needed in preparation for the engineering studies, together with such additional matter as is necessary to fill in the gaps, and so round out the course that the student is made a *thinker*, instead of a mere servile formula twister. The professor of mathematics should be allowed to use his own methods of presentation, and no other teacher, "Napoleonic" or otherwise, should be allowed to interfere or dictate in any way. If the required results are not then forthcoming, the conclusion is evident; either the professor of mathematics does not know his business, or the professor of engineering is incompetent to prescribe what ought to be done, or else both of them are incompetent. The remedy is simple. Locate the responsible party, and create a vacancy in his chair at once. If this plan is followed, students can get the instruction really needed, worthless instructors will be got out of the way, competent men will have something to work for, and the cause of education will be advanced. This is no new and untried plan; it is followed here[2] with excellent results, and that other institutions are working on the same or similar lines is seen by the fact that the University of Wisconsin has added to its Faculty a professor of applied mathematics, whose duty is to teach exclusively mathematics as applied to engineering.

On the same plan, thoroughly good electrical work can be done in the physical department. Prof. Stine says this plan is open to criticism, yet a few paragraphs back he laments that "In the majority of cases the professors of chemistry, physics, and even mechanical engineering are content beyond a somewhat general idea of the subject, to leave all matters electrical to the professor in that department." I shall not try to reconcile these two statements. If the elementary work in electricity and magnetism is done in the physical department properly, and it can be, by following the plan just given, the department of electrical engineering will be much benefitted, by gaining more time for advanced work. I venture the assertion that to-day one of the greatest stumbling blocks to progress in most electrical engineering courses is that a large amount of the professor's time has to be wasted in giving the kind of elementary instruction which had better be done in the department of physics. As to the assertion that the professors of physics, mechanical engineering, etc., leave all matters electrical, beyond a somewhat general idea, to the professor in that department, I can only ask, if it is not exactly the duty of "the professor in that department" to handle the more advanced work, then what is he there for?

Enough has been said to show the looseness of the educational views in the paper. I shall next try to show that the statements regarding an electrical engineer's duty and qualifications are not in conformity with the demands of actual practice. Prof. Stine's proposition, if he makes any, is this:—The proper course for an electrical engineering student should confine itself principally to electrical matters; mechanical engineering, shop practice, etc., being excluded, or else given in a very elementary manner, since proficiency in these latter branches is not now essential to the electrical engineer, or at least is less important than it was formerly. It is essential that we first obtain a clear idea as to what constitutes an electrical engineer. Prof. Stine does not tell us, though he defines an electrician as "one who is concerned mainly with the construction and maintenance of applied electrics." If an electrical engineer is different from this, I would like to know the distinction.

An engineer, using the term in its highest sense, is one engaged in utilizing the forces and materials of nature. He differs from the mere mechanic or craftsman in so far as he is able not only to execute the designs of others, but to strike out for himself, make new applications of scientific principles, and thereby improve on what has been done by others. He must therefore deal not only with *forces*, but the *matter* which acts as the vehicle of those forces, hence an accurate knowledge of the properties of matter is essential to him. He must further understand the processes of working at the least expense such matter or material as he has occasion to use, and this requires a knowledge of many kinds of machinery; not necessarily how to design and build all such machinery, but what machinery available for his purpose is in the market, its limits of performance, and the most economical method

1. *Electrician*, Nov. 2, 1894.

2. Michigan Mining School, Houghton, Mich.

of operating it. Without further enumeration it is evident that no engineer of consequence can be a narrowly educated, or "one horse" individual.

What distinguishes the electrical from any other engineer? Merely that he makes a specialty of utilizing *electric forces*, by the generation, storage, transmission, or industrial application of electricity. He does this either by designing, building, installing or operating the necessary machinery and appliances; hence he will be either a designer and builder of apparatus, a constructing engineer, chief engineer of a plant, or a consulting engineer. If the first, he must, in case he is to be more than a mere calculator working under a superior's direction, understand thoroughly not only electrical science, but the properties of engineering materials, the principles of machine design, the capacity of the tools in his establishment, what range of work he can do economically with them, and the cost of such work. No matter how perfect electrically his machines and appliances may be, they will be worthless if not mechanically correct. Indeed, perfection in mechanical detail and execution is more vital than electrical efficiency, for without the former, such machines are useless; hence I deny that "the mechanical considerations in electrical design are now rather secondary to the electrical conditions in any given device." Prof. Stine says "the mechanical proportions and relations in the design of electrical apparatus have reached a point of somewhat general agreement." Yes, *somewhat*, but what does that amount to? Steam engines reached that point years ago, yet perfection in them is not yet attained, and the highest class of engineering knowledge and skill is daily in demand to solve new problems arising in connection with such machines. To no less degree is this so of dynamos, the numerous types of which are far less similar than is the case with engines. What progress would be made if we kept on copying the lines and proportions of old machines? Such procedure would lead to disaster, and is beneath the dignity of a reputable engineer. The word engineer, from its derivation, means one who brings forth or produces, and involves therefore "the idea of originating, of advancement, of development, of passing from the known to the unknown, from the certain to the uncertain, from that which is accomplished to that which is desired."[3] It includes nothing of the servile imitator or copyist.

The constructing engineer, who is to design and put in a plant has to deal not only with dynamos, switchboards, conductors, etc., but with the most economical design for the plant as a whole. He must determine the best type of engines and boilers to use, he must know when to compound and when not; whether it is better to put the station where condensing water can be got, or nearer the centre of distribution; see that the buildings have the proper layout, and are capable of carrying dynamos, boilers, fuel, etc., on the upper floors, if necessary; he must consider the foundations for his machinery, determine whether belt driving, or direct connection is best, and handle many other such problems. Even the determination of the most economical size of conductor requires a knowledge of the cost of producing power. How much of this work is purely electrical? Comparatively little, and that little not of the most difficult sort of engineering.

The main part of the work falls entirely within the duty of the mechanical engineer, and no man trained in electrical engineering as it seems to me Prof. Stine wants it taught, can handle such work with success. I have seen some attempts of that sort, where electric railways were put in by boys fresh from electrical courses, and without training in mechanical engineering. The railway companies are not paying dividends just now, and are not liable to do so until the steam plant undergoes some severe doctoring, to prevent the profits from flying up to the chimney. It is exactly this kind of men, ignorant of steam engineering, who buy the worthless engine Prof. Stine tells us about.

The chief engineer of an electrical plant should thoroughly understand the electrical appliances under his charge, know how to make all required tests to determine the efficiency of the machines, and defects in lines, and be able to correct any defects found. He must be able to determine whether extensions to the plant are desirable, what apparatus is best to use in such case, what the cost of work will be, etc. Sound electrical training is requisite for the best performance of such work, but proficiency in mechanical engineering is just as requisite. The chief engineer has the oversight of the whole plant, and he should understand every detail of it, from the coal pile to the consumer's lamp. He must know just as well how to test his boilers and engines as how to test his dynamos, and if he does not, he must hire others to do such work, or the profits are liable to go up the chimney, or down the exhaust pipe. The machinery must be kept in the pink of condition, repairs must be made judiciously and promptly, liability of failure of some part of the machinery must be looked to, and provided for beforehand, if the service is not to be interrupted. All this lies within the province of the mechanical engineer, and no man unskilled in such work can run a station at its highest efficiency. There are to-day stations running and giving good satisfaction, which are directed by mechanical engineers of rather limited electrical attainments. I can recall some others run entirely by the electrical end of the concern. No customer dares to dispense with his oil lamp, for the regular programme seems to include a shut down about once a week, to tinker with some hot box, etc.

The consulting engineer will be called upon to give advice and assistance in all such work as has been discussed. He will therefore require the same kind of knowledge of mechanical engineering, perhaps even a deeper knowledge of it, as the simpler problems are not usually brought to him.

If so far my views are correct, it inevitably follows that he who desires to succeed as an electrical engineer, must of necessity be an adept in many branches of mechanical engineering. He must know the general principles of *all* engineering, and no amount of electrical knowledge alone will make him an engineer, any more than a knowledge how to turn up governor balls will make one a machinist. If then, such are the requirements of actual practice, it follows that judging "from the standpoint of the actual needs of those engaged in active electrical work," thorough training in mechanical engineering is absolutely necessary, and justifies, nay, renders necessary "the undue attention paid to the mechanical engineering aspect" in the higher grades of technical schools. The electrical engineer *does* need the "practical training in pattern making and wood working, forging and machine shop practice." Without it, or its equivalent, his course in life will be marked by many an anxious hour.

I therefore lay down the proposition that no course in electrical engineering, irrespective of the thoroughness with which the electrical work alone is done, can properly prepare men for active practical engineering work according to the requirements of to-day, unless such a course includes a thorough training in the fundamental principles of mechanical engineering. I am not alone in this view. Hutton says: "Those interested may give thought to the logical embarrassment occasioned where a course in electrical engineering is created before the establishment of a fundamental course in mechanical engineering upon which it can be based; to the dependent relation of the instruction in electrical engineering upon the department of engineering in its broad sense; and to the necessary pre-existence of the mechanical laboratory for the satisfactory training of the electrical engineers. Or, finally (and this is the question to which the whole discussion has been intended to lead), would not the end be best subserved by making the course and degree of mechanical engineer in the university cover so much of electrical knowledge in addition to its other requirements as would render its graduates competent for the positions which they are likely to be called to fill?"[4] Lanza, in a valuable paper on Engineering Practice and Education, says: "These illustrations will suffice to show that one who is not an *engineer* cannot be an electrical engineer, and that the greater portion of the work of the electrical engineer is such as to require a knowledge of other branches of engineering."[5] Dr. Henry Dyer writes: "Nowadays, construction in metal and the use of mechanical appliances of all kinds are so general in civil engineering work that some experience in mechanical engineering may be looked upon as a necessity. The same, is true, in fact, of all departments of engineering, and especially of electrical engineering. The electrical engineer of the future will be a mechanical engineer who has added to his mechanical knowledge and experience a special knowledge of the applications of electricity. At the present time there is a great rush of young men to electrical engineering, who seem to think that they can acquire the greater part of the training they require by attending a college course and obtaining a little experience of the applications of electricity in a laboratory. They are certain to be disappointed, and unless they qualify themselves in a more thorough way they cannot possibly obtain success."[6]

I omit discussion on the ideas of education of "electricians." Such a course as advised would perhaps produce men who, like graduates of the manual training schools, would be useful in very subordinate positions, but valueless so far as real engineering is concerned.

In conclusion, I wish to say that as one actually engaged in engineering education I shall welcome anything showing us how to make technical education conform as closely as possible to the needs of actual practice. All parties concerned would be greatly benefitted were more written on this important subject by men whose experience as practical engineers, or as technical educators qualifies them to give advice in this matter. We have already had too much from men who know little of either engineering or education. Will not THE ELECTRICAL ENGINEER take up the subject from the standpoint named, and induce practical electrical engineers of eminence to give their views on this important matter?

MICHIGAN MINING SCHOOL, HOUGHTON, MICH.

DOVER, N. H.—Dover is talking of putting in a local telephone system, subscribers to pay but two dollars a month.

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3. Eckley B. Coxe, *School of Mines Quarterly*, Vol. IX., p. 347.

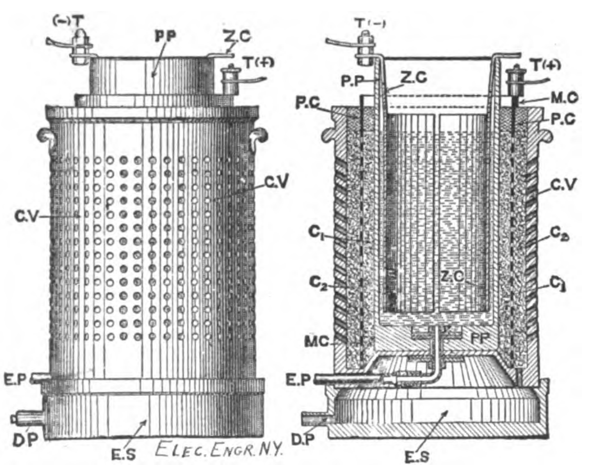
4. School of Mines Quarterly, Vol. ix, p. 73.
5. Journal Franklin Institute, September, 1894, p. 216.
6. Industries and Iron, 7th July, 1893, p. 102.

THE WALKER-WILKINS BATTERY.

A series of tests were recently made by Prof. Andrew Jamieson on the Walker-Wilkins non-polarizing voltaic battery. The cell consists, as shown in the accompanying illustrations, of an amalgamated split cylinder of zinc immersed in a solution of caustic potash, contained in a porous pot, placed concentrically within a perforated outer vessel. The space between the vessels is packed with carbon, that in contact with the porous pot being powdered while that next the outer vessel is granular. The current is collected by means of a perforated nickel cylinder embedded in the granular carbon.

Referring to the illustrations, T + and T — are the terminals attached, respectively, to the metal cylinder M C and the zinc cylinder Z C. The porous pot P P is surrounded by powdered carbon C_1 and granular carbon C_2 separated by the metal cylinder M C and covered with the pitch covering P C. The emptying pipe E P connects with the bottom of the porous pot and the containing vessel C V is drained by means of the pipe D P in the earthenware stand E S.

In the E. M. F. test a current of a certain value was obtained from the cell for periods of five minutes each. At the end of each period the potential difference and current were simultaneously noted. The external resistance was then reduced so that the current was increased until it had risen from .156 ampere at the beginning to 1.846 at the end of the test. Eleven readings in all were taken, the E. M. F. being 1.343 at the beginning and 1.264 at the end, with the currents mentioned above. The total output was 250 ampere-hours with a consumption of .69 pound of zinc. The theoretical weight of zinc required for this output is only .67 pound, so that the efficiency of the cell was 97 per cent. The



THE WALKER-WILKINS BATTERY.

internal resistance of the two cells tested was .112 and .161 ohm, respectively.

The three-cell oval type of the same battery was tested at the same time and proved as satisfactory as the others. This battery consists of a combination of three cells, joined in parallel. Each cell is similar in internal construction to those already described; but the carbon of each cell is surrounded by a thin perforated metal cylinder instead of the earthenware containing vessel, while another oval perforated vessel of the same material surrounds the three cells. This greatly reduces the weight for a given output. The total length, including the insulated handles, is 21 inches by 5¼ inches broad, and 11 inches high, the weight being approximately 30 lbs. Each set of three cells is intended to give a current of six amperes at about one volt potential difference. The exact output of this cell was not ascertained, but the tests showed a remarkably constant current with a slight drop in voltage, and Prof. Jamieson affirms that the battery is the best of its kind that he has ever tested.

ELECTRICITY AT PALMER'S THEATRE.

An interesting, though exceedingly simple, application of electricity to scenic effects has been devised by the electrician of Palmer's theatre to represent the bomb explosion in the last act of "The Fatal Card." The bomb, arranged to explode by means of clockwork, stands on a table in the half dark room. Just as it is about to go off it is picked up and hurled through the window. There is a vivid flash, a crash and a roar and the scene falls to pieces, leaving a mass of smoking ruins. The illusion is complete and the climax most striking.

As a matter of fact the bomb does not explode at all. At the instant that it passes through the window a small brass yacht cannon, concealed behind the flat is fired and produces the flash, the detonation and the smoke in one operation. In order to make sure that the cannon should go off at exactly the right moment it was decided to resort to electricity. On either side of the touch hole is placed a binding post insulated from the cannon. To these two posts are led wires from the switchboard and between them is held a piece of fine bell magnet wire, which completes the circuit but is much too light to carry the current. The instant, therefore, that the circuit is closed by touching a button at the switchboard the magnet wire is fused and falls upon the loose powder of the priming, the gun is discharged, the villain's crimes are avenged, the lovers are united and everything winds up in the good old melodramatic fashion.

The electric equipment of the theatre was put in nine years ago and is, therefore, not up to date in every particular, but Mr. Driscoll, the electrician of the theatre, has succeeded in producing effects which are not exceeded in houses furnished with much more modern apparatus. The alternating street current at 2,000 volts is brought into the basement where 34 transformers of 30 and 40 lights capacity convert it to 50 volts. About 600 lights are taken from these converters on the various circuits, all controlled from the main switchboard at the edge of the stage.

ON A PROPOSED MODIFICATION OF THE GENERALLY ACCEPTED TEMPERATURE COEFFICIENT OF RESISTANCE FOR COPPER WIRES.

BY A. E. KENNELLY AND REGINALD A. FESSENDEN.

IN a paper entitled "Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper," read at the International Electrical Congress, at Chicago, 1893, and also published in the *Physical Review*, Vol. I, No. 4, page 260, the authors showed that the temperature coefficient of resistance at any temperature ($t°$ Centigrade) of a sample of good commercial copper wire, which appeared by chemical analysis to have a high degree of purity, could be very closely represented by the formula,

$$\rho_t = \rho_0 \, (1 + 0.004065 \, t) \qquad (1)$$

Recent determinations by Messrs. Dewar and Fleming and Messrs. Swan and Rhodin concur in giving a linear relation between temperature and resistance.

As the results of measurements made to determine the temperature coefficient in annealed copper wire, we have for the range from 0° C. to 100° C., assuming a linear relation, as follows:—

Benoit	.373
Cailletet and Bouty	.425
Matthiessen	.428
Siemens	.388
Dewar and Fleming	.424
Kennelly and Fessenden	.406
Swan and Rhodin	.415
We obtain as the mean	.4076

We therefore suggest that since the exact temperature coefficient is not yet determined, and since it may possibly vary in different samples of copper in commercial use, that the simple formula,

$$\rho_t = \rho_0 \, (1 + 0.004 \, t) \qquad (2)$$

may be accepted provisionally for all practical purposes, or, in other words, that the resistivity of copper be considered to increase by 0.4 per cent. per degree centigrade of temperature elevation reckoned from the resistivity at zero centigrade.

Should the corrected coefficient be subsequently determined to be 0.0041, formula (2) would become,

$$\rho_t = \rho_6 \, [1 + 0.004 \, (t - 6)] \qquad (3)$$

ρ_6, being the resistivity at 6° C.

Similarly, if the coefficient subsequently accepted should be 0.0042, the corresponding formula would be,

$$\rho_t = \rho_{12} \, [1 + 0.004 \, (t - 12)] \qquad (4)$$

ρ_{12}, being the resistivity at 12° C.; and for an accepted coefficient of 0.0043,

$$\rho_t = \rho_{17.5} \, [1 + 0.004 \, (t - 17.5)] \qquad (5)$$

Consequently, if we adopt equation (2) at the present time, we obtain, pending more exhaustive enquiry, a formula much simpler, more convenient, and probably more nearly accurate than that of Matthiessen, while any future correction can only have, it would seem, an influence upon the standard or datum temperature, and a comparatively trivial quantitative effect within ordinary temperature ranges.

PERSONAL.

MR. J. P. B. FISKE, who for four years held the position of Chief Engineer of the Motor Department of the Thomson-Houston and General Electric Co's. and who resigned this position last June to associate himself with the Morgan Engineering Co., of Alliance, Ohio, has just severed his connection with the latter concern.

LITERATURE.

Electrical Boats and Navigation. By Thomas Commerford Martin and Joseph Sachs. New York, 1894. C. C. Shelley. 224 pp. 6x9. Cloth. Price, $2.50.

MUCH work that has resulted in a highly practical outcome has been inaugurated by the amateur, and the lines of effort and experiment which electricity offers to these valuable members of society are constantly broadening. The desire for a method of propelling pleasure boats, which shall relieve the occupant of the drudgery of the manual labor usually attached to it and be free from the annoyances and personal discomforts inseparable from the employment of steam for such purposes, has awakened an interest in the application of electricity for this purpose. And still more recently even, the wants of the pleasure seeker have been crowded into the background by the demands of commerce in seeking a way to add to the value of existing canals by introducing an improved motive power for the propulsion of canal boats. The time for a work such as that before us seems, therefore, eminently ripe, and while the entire subject may be said to be still in a state of evolution, enough facts and data are available to guide those who desire to take up this branch of electrical work.

In the introductory and historical chapter we find an authentic but brief account of the experiments of Jacobi with his electric boat on the Neva at St. Petersburg, in 1838, and those of other later experimenters with primary batteries, both in this country and abroad. Among these is the indefatigable Mr. Trouvé whose various devices are illustrated and described, including that most remarkable suggestion of a raft battery, in which the electrolyte employed is the sea water itself, into which the electrodes dip and which are hauled along after the boat to which they furnish the propelling power. We agree with the authors that it is almost too much to expect that we shall ever see a large ship, or, for that matter, a small one, hauling an acre or two of such batteries across the sea.

It is only when we come down to the storage battery that the true problem of electric boat propulsion is really touched, which the authors begin with a description of the "Electricity," the pioneer storage battery launch, built by the late lamented Anthony Reckenzaun, to whose memory, by the way, the volume is dedicated. To this is added the description of a number of most important storage battery launches and their equipment, thus far built, including that for Mr. John Jacob Astor, a 46-foot, twin screw, cabin, cruising launch, called the "Progresso." For those who contemplate the establishing of storage battery launch fleets for business purposes, the chapter giving the estimate of cost of equipment and operation of such fleets will prove of particular interest. This chapter also contains the results of the operation of the fleet of 50 launches which constituted one of the most pleasing features of the World's Fair at Chicago in 1893. The opportunities for street railway companies in this direction are well shown in the chapter devoted to the special features of storage launch operation and charging, in which a number of installations are described, where the charging is done from the railroad circuits which run out to lakes situated at some distance from the cities. A chapter on special electrical craft, such as row boats catamarans and paddle wheel boats, describes a number of interesting and some curious experiments that have been carried out by enthusiastic amateurs in this branch. Passing from peace to war, we also have descriptions of the various submarine electric torpedo boats and dirigible electric torpedos, which will well repay study, as illustrations of methods designed to obtain the greatest amount of power in the smallest possible space.

Perhaps the first question which an intending purchaser or builder of an electric craft asks, is "how much power will it take?" and the authors have anticipated this query by a chapter, in which this question is discussed. They give simple tables showing the capacity and size of motors, number of cells, etc., required for boats varying from 18 to 70 feet in length, and also useful information as to the amount and cost of charging cells.

The proposition looking towards the introduction of electric motive power on the Erie Canal makes the chapter devoted to canal boat propulsion of special interest at this time. The authors have gone into the question as fully as the present state of the experiments and known facts permit, and give an account of the work done on the Erie Canal in an experimental way, as well as that in a number of instances abroad, more particularly in France. We note also special chapters devoted to the elucidation of the resistance to propulsion of canal boats and a comparison of the cost of propulsion by propeller as against the hauling method, which has been advocated and which seems to have some strong points in its favor. A final chapter on the storage batteries, motors, and dynamotors used in connection with electrical navigation will enable those not familiar with these essential parts of an electrical craft to obtain a fair idea of their nature.

As we have intimated above, the work is not a treatise on a well-established art, but is more in the nature of an attempt to place before the reader an accurate and interesting account of what has been done up to date in what promises to be a most important application, and that at no distant time. As such, it has a distinct value, and indeed, as the only work on this subject which has thus far appeared, it is a welcome addition to the literature of electricity. The copious illustrations, of which a large number are diagramatic, scattered throughout the work add much to its value.

LETTERS TO THE EDITOR.

THE MAGNETIC BRUSH HOLDER.

Referring to a description of the Henry Magnetic Brush Holder in THE ELECTRICAL ENGINEER of February 6th, it is but fair to call attention to the fact that although possibly novel with Mr. Henry, the scheme itself is not original.

As long ago as 1888, "the days of Richmond," a period which was pregnant in suggestions of most modern practices and novelties in electric railway operation the Sprague Electric Railway and Motor Company had a shop at 510 West 30th Street, in charge of Mr. Oscar T. Crosby, and it was at this shop that this same idea of a magnetic brush holder, that is, one having an initial spring tension and arranged with a solenoid in the main circuit to increase the tension with an increase of load, was tried under my direction and after my plans on the old No. 5 Sprague Railway motors.

I mention the above facts in the interest of history. A number of people connected with the Sprague Company at that time, Messrs. Crosby, Parshall and O'Shaughnessy saw, I believe, these experiments.

FRANK J. SPRAGUE.

NEW YORK CITY, Feb. 7, 1895.

LEGAL NOTES.

A TELEPHONE TOLL TEST CASE.

A temporary injunction has been secured by Mr. Simon Stern restraining the Metropolitan Telephone and Telegraph Co. from removing the telephone instrument at present in use in his office, from interfering with his use of it, from disconnecting the wires with others, and from interfering in any way with his use of the telephone which he has in his office, or with the general telephone service.

The injunction is accompanied by an order to show cause why the injunction should not be continued during the pendency of an action which Mr. Stern has brought in the Supreme Court to test the power of the company to cut off his service.

The action is the result of the company's increase of rates for the metallic circuit service and the compulsory substitution of new instruments for old.

SOCIETY AND CLUB NOTES.

FULL PROGRAMME OF THE N. E. L. A. CLEVELAND CONVENTION.

We have received from Secretary Porter the following full programme of the Cleveland Convention:

TUESDAY, February 19, 1895. Meeting of the Executive Committee at 9 a. m., parlor 138, Hollenden Hotel. *Morning Session*, 10.30 o'clock, Army and Navy Hall. Address of Welcome: By Mayor of Cleveland. President Francisco's Address. Paper by N. W. Perry: The Storage of Energy Essential to Central Station Economy: How It May be Accomplished and the Economies Resulting. Discussion. John W. Langley, W. M. Stine, M. J. Perry. Report of Committee on Relations Between Manufacturing and Central Station Companies, Frederic Nicholls, Chairman. *Afternoon Session*, 2 o'clock. Paper by E. J. Houston and A. E. Kennelly: A New Method of Measuring Illumination. Discussion. W. A. Anthony, C. D. Haskins, W. S. Howell, Edward Weston, L. Stieringer. Report of Committee on Data, H. M. Swetland, Chairman. Discussion. W. R. Gardener, E. L. Powers, H. W. Sexton. Paper by Walter E. Harrington: Correct Method of Protecting Electric Circuits. Questions and Answers. What Is It You Wish to Know? Executive Session.

WEDNESDAY, February 20th, *Morning Session*, 10 o'clock. Paper by Edward Weston: Some Economies in Electric Light and Power Stations. Paper by C. N. Black: Large Arc Dynamos. Discussion. S. M. Hamill, J. J. Wood, F. W. Rollins, E. R. Weeks. Topic: How to Light Large Cities. Discussion. Frederic Nicholls, Geo. A. Redman, Jas. I. Ayer, E. F. Peck, C. R. Huntley, Robert Lindsay, F. H. Clark, T. C. Smith, J. F. Morrison. Report of Com-

mittee on Finance, John A. Seely Chairman. Questions and Answers. What Is It You Wish to Know? Executive Session.

Afternoon Session, 2.30 o'clock. Paper by E. A. Leslie: The Operation of High Tension Currents Underground from a Physical and Financial Standpoint. Discussion. H. J. Smith, W. H. Browne, C. H. Wilmerding, John A. Seeley, C. L. Edgar. Paper by L. B. Marks: Arc Carbons and the Rating of Arc Lamps. Topic: Incandescent Lighting vs. Other Methods. Discussion. H. T. Edgar, E. F. Phillips, W. S. Barstow, E. A. Armstrong, J. Gynn, B. P. Holmes. Questions and Answers. What Is It You Wish to Know? Executive Session. *Evening Session*, 8 o'clock. Topic. By A. J. Wurts. Practical Demonstrations of Protecting Lines from Lightning.

THURSDAY, Feb. 21st. *Morning Session*, 10 o'clock. Paper by Dr. Louis Bell: The Monocyclic System. Discussion. A. E. Kennelly, L. B. Stillwell, J. F. Kelly. Report of Committee on Rules for Safe Wiring, Wm. J. Hammer, Chairman. Topic: Underwriters' Rules vs. National Electric Light Association Rules. Discussion. Wm. Brophy, C. J. H. Woodbury, J. J. Burleigh, A. W. Field. *Afternoon Session*, 2.30 o'clock. Executive Session. Report of Secretary and Treasurer. Executive Committee. Election of Officers.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

The Department of Electricity of the Brooklyn Institute of Arts and Sciences held a meeting at the Edison Building, 360 Pearl street, Brooklyn, on Friday, February 1. Mr. John F. Skirrow read an interesting paper on "Telegraph Engineering in the New Postal Telegraph Building, New York" fully illustrated by lantern slides. A large and appreciative audience attended the lecture.

"THE DANCING AT ODD FELLOWS' HALL."

The members of the Massachusetts Electrical Engineers and Mechanics' Association held their fifth annual ball in Odd Fellows' Hall, Boston, on January 21. These events are always marked by unique and beautiful electrical displays and this one was no exception to the rule. Streamers of colored incandescent electric lights radiated from the chandeliers to the sides of the hall. On one side was the word "Welcome" in letters of electric lights, and the abbreviation "M. E. E. & M. A." was in colored bulbs over the heads of the orchestra on the platform. Suspended from and close to the ceiling was the symbol of the association, Franklin's kite, with a key in its centre, worked out in white and red bulbs. Two handsome arc lights hung from the ceiling.

There was a switch board in a corner of the hall, where an operator stood all the evening sending the current at intervals through the red, yellow and white globes. Suddenly the kite and key would burst into color, followed by the lighting of one or both of the mottoes. The operator was able to make a great many combinations. Bunting and small flags were all over the hall.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEB. 5, 1895.

Accumulators:—

Separator Plate for Storage Batteries, P. G. Salom, Philadelphia, Pa., 533,751. Filed May 9, 1894.
Consists of a perforated crimped pipe.

Alarms and Signals:—

Electric Fire Alarm and Police Signal Box, G. E. Paynter & W. H. Thompson, Richmond, Va., 533,490. Filed May 4, 1894.
A releasing lever is normally engaged by a locking device and released by the sliding movement of a key upon its insertion in the door.

Conductors, Conduits and Insulators:—

Insulated Conductor, H. G. O'Neill, Boston, Mass., 533,607. Filed Mch. 22, 1894.
A covering consisting of an inner coat composed of a paste of powdered silicate of magnesia and soda and the outer coat of a mixture of dilute lime, albumen and lactic acid.

Distribution:—

Electrically Lighted Buoy, I. W. Henry, New York, 533,459. Filed May 29, 1893.
A buoy fed by alternating currents from a transformer placed on the buoy.

Dynamos and Motors:—

Electric Dental Motor Apparatus. F. N. Denison, Toronto, Can., 533,445. Filed May 26, 1894.
A special arrangement of dental table and motor.

Elevator, A. B. See & W. L. Tyler, Brooklyn, N. Y., 533,500. Filed Nov. 27 1894.
Claim 1:—
An electrically operated elevator provided with a guide fixed in the car, a rod accessible to the operator mounted within the guide and extending through the car, and a controlling switch mounted upon the outside of the car connected to the rod.

Brush for Dynamo Electric Machines, J. W. Dickey, New York, 533,583, Filed Dec. 8, 1894.
A woven wire brush in which the individual wires of the mesh run angularly to the parallel side of the brush; a second shorter piece of wire cloth is placed over the main blank and in reverse position to it.

Electro-Metallurgy:—

Apparatus for Refining Metals by Electrolysis, H. A. House, Bridgeport, Conn., 533,596. Filed May 2, 1894.
A rotating cathode is employed with a scraper for removing the film of metal as the cathode revolves.

Lamps and Appurtenances:—

Method of and Means for Testing Incandescent Lamps, F. S. Smith, Pittsburgh, Pa. & J. A. Vandegrift, Allegheny, Pa., 533,502. Filed July 9, 1894.
The inventors apply the glow test with a high tension current to determine the condit on of the vacuum of the lamps on the pumps before switching on the current for expelling the occluded gases from the filament.

Lock for Electric Lamps, W. A. Saul & J. H. Peck, Steelton, Pa. 533,670. Filed Mch. 13, 1894.
An electric light chain permanently connected to a plate or link by one opening and a cord provided with a hook by which it may be connected to the remaining hole of the plate or link.

Cover for Electric Light Globes, H. Johansen, Chicago, Ill., 533,853. Filed June 30, 1893.
A mica sheet centrally perforated for the passage of the carbon, separated by radial cuts into sectors, and rigidly secured at its outer margin to the cover, and cylindrically rounded supports fixed beneath the sectors to prevent the latter from bending sharply when depressed.

Miscellaneous:—

Mariner's Compass, J. A. Hooper, Boston, Mass., 533,465. Filed March, 2, 1894.
Claim 1:—
In a compass the combination with the card spindle, of a pair of jaws adapted to clasp the lower end of the card spindle, and a lever and connections between said lever and jaws.

Electric Bathing Apparatus, C. Doehring, New York, 533,791. Filed June 22, 1894.
Consists of two flexible metal sheets between which an electric current is generated and of a bed of heated sand in which the bather is packed while subjected to the electric action between the sheets.

Electric Broiler or Toaster, L. T. Edwards, Haverford, Pa., 533,795. Filed March 2, 1894.
Consists of wires mounted on a frame and stretched taut by springs.

Apparatus for Stopping Engines, F. D. Taylor, Hartford, Conn. (Reissued), 11,470. Filed Jan. 3, 1895.
A magnet controls a lever through the medium of which the throttle valve of the engine is closed.

Railways and Appliances:—

Electric Railway, J. G. Douty, Williamsport, Pa., 533,447. Filed May 17, 1894.
A system in which one of the rails forms one half of a slotted conduit, the other half of the conduit being covered by a channel bar section under which the conductor is suspended on insulators.

Running Gear for Electric Cars, C. A. Jackson, Reading, Mass.. 533,598. Filed Sept. 15, 1893.
Claim 1:—
The combination of the axle having a ring affixed thereto, a wheel having a recess to receive one-half of said ring, and a clutch-block having a recess to receive the other half of the ring, and a flange bolted to the wheel.

Conduit Electric Railway, A. Rosenholz, San Francisco, Cal., 533,610. Filed May 22, 1894.
A conduit system in which switch boxes located at intervals close the circuit to the feed wires by being tilted by contact mechanism attached to the passing car. When the car is passed the switches resume their normal position and open the circuit to the feeders.

Conduit Electric Railway, W. H. Baker, Pawtucket, R. I., 533,627. Filed May 18, 1894.
The system consists practically of trolley wires placed under ground on which run trolleys similar to the overhead system.

Trolley for Underground Conduits, C. M. Yost, Washington, D. C., 533,772. Filed Nov. 3, 1894.
Claim 1:—
Two separately swiveled, spring supported trolley-arms, combined with means for simultaneously turning the same.

Subway for Electric Railways, F. E. Button, Rochester, N. Y., 533,631. Filed June 6, 1894.
Claim 1:—
The combination with opposite rails, a cross-sleeper arranged beneath the rails, and a tie bar having a downwardly deflected central portion secured to the cross sleeper, and upwardly extending extremities secured to the rails.

Conduit System, C. M. Yost, Washington. D. C., 533,836. Filed Nov. 3, 1894.
An arrangement whereby alternately arranged conductors are employed so connected that the trolleys which are in pairs will alternately contact with the conductors; one contacting before the other has left the conductor upon which it is traveling.

Switches and Cut-Outs:—

Rosette for Electric Lighting, E. W. Buffington, Fall River, Mass., 533,484. Filed Oct. 6, 1894.
The lamp cord is held and secured without the use of screws, the fastening screws being protected from forming connections with the lamp cord.

Safety Connection for Electric Conductors, R. E. Bates, Brooklyn, N. Y., 533,696. Filed June 20, 1894.
A device for cutting out the circuit upon the rupture of a wire or a diminution of its normal tension.

Telephones:—

Automatic Telephone Switch, H. D. Bayne, Brooklyn, N. Y., 533,497. Filed May 31, 1894.
A switch applicable to single or double pole systems or to three point switches.

Telephone Arm Rest and Receiver Holder, W. Stuebing, Cincinnati, Ohio, 533,619. Filed Oct. 30, 1894.

Telephonic or Analogous Electrode, T. McCoubray, New York, 533,720. Filed Aug. 9, 1894.
Claim 3:—
The described method of preparing a carbon powder from the residuum of petroleum distillation, consisting in crushing or grinding said material into a powder-like form, then passing the powder through a sieve of given mesh and again separating the finer particles from the coarser, and finally carbonising the particles retained in the second sieve.

Telephone Exchange, M. Brooks, Minneapolis, Minn., 533,785. Filed Oct. 17, 1894.
A system in which subscribers are connected not by actual contact between circuits but through induction from one circuit to another by suitable arrangement of coils.

NYACK, N. Y.—There is a movement on foot looking to the formation of a new telephone company in Nyack.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NIKOLA TESLA COMPANY.

The Nikola Tesla Company has been incorporated in New York City, to manufacture and sell machinery, generators, motors, electrical apparatus, &c., capital $5,000. The directors are Edward D. Adams, Ernest K. Adams, Alfred S. Brown and William B. Rankine of New York City, and Charles F. Coaney of Summit, N. J.

SCHUCKERT MOTORS FOR INDUSTRIAL PURPOSES.

We have received from Messrs. Schuckert & Company, Nuremberg, a beautifully printed catalogue, showing the variety of work to which electric motors of their manufacture have been applied. The motors have gone into use for ventilation, there being a number of types of fan motors, elevator driving, running printing presses, circular saws, pumps, stamping presses, buffing wheels, lathes, drills, grind-stones, wood-working machines, etc. The usual form of motor built by Messrs. Schuckert & Company is of the iron-clad type.

THE SUBURBAN TELEGRAPH COMPANY.

The Suburban Telegraph Company of Westchester, N. Y., has been incorporated with a capital of $10,000 to construct and maintain a line of telegraph or telephone from Westchester to New York city and Brooklyn and to connect with the principal cities and towns in the counties of Westchester, New York, Kings, Queens, and Suffolks, and also in the counties of Erie and Saratoga and other towns and cities in this and other States. The directors are William Bryant, James McCullom, Thomas P. Tighe, Thomas Conlon, Michael McGonigle, George E. Shepard, and Thomas Lloyd of this city.

SPRAGUE-PRATT ELEVATORS FOR SAN FRANCISCO.

We learn that the Sprague Electric Elevator Co. has been awarded the contract of fifteen electric elevators in the Parrot Building, San Francisco, in competition with several hydraulic elevators. Eleven of these are of the Sprague-Pratt multiplying sheave type and four of the new Sprague tandem drum type.

This is one of the largest buildings and one of the largest elevator plants in the world, and coming immediately after the awarding of the machines for the Boston *Globe* Building and the New York Custom House to the Sprague-Pratt system indicates very strongly the passing of the hydraulic elevator.

PROPOSALS FOR BURYING POLICE AND FIRE ALARM WIRES IN BALTIMORE.

An announcement in our advertising columns gives the details of the proposals called for, for installing an underground system of police and fire alarm telegraph and police patrol system in the city of Baltimore.

The equipment will include 180,000 feet of bunched cables, from two to eighty conductors, drawing in, splicing and connecting, pole terminal boxes, house terminal boxes, cable terminals, test boards, lightning arresters, etc. The work will be supervised by Mr. N. S. Hill, engineer to the Underground Construction Committee of Baltimore.

WARREN WEBSTER & CO.

The month of January was a very good one in booking contracts for Warren Webster & Co., who received some very large ones for their Webster vacuum feed water heater and purifiers, receiving in some contracts payment in the monthly savings in fuel until their invoices are paid in full. Among the purchasers were the following:—Glen Manufacturing Co., Berlin, N. H.; Messrs. Sayles & Jenks, Warren, Mass.; Messrs. F. R. Walker & Son, Burnside, Conn.; Beaver Tin Plate Co., New Lisbon, O.; The Johnson Co., Lorain, O.; Hurlbut Paper Mfg. Co., South Lee, Mass.; Estate of C. H. McCormick, Chicago, Ill.; M. Guggenheim's Sons, New York; Midvale Steel Co., Nicetown, Phila., Pa.; J. H. Horne & Sons Co., Lawrence, Mass.

REMOVAL OF THE NEW YORK ELECTRIC EQUIPMENT COMPANY.

The New York Electric Equipment Company, finding its business has altogether outgrown the facilities of the Duane and Elm street quarters, has removed its principal offices and sales rooms to the new and commodious building occupied by its works at 572 to 578 First avenue, corner of 33d street. The new quarters are tastefully and handsomely fitted up, and most conveniently arranged. The visitor first enters a large ante room on the second floor. To the right is the president's office; beyond this are the counting rooms and the sales department, while the rest of the floor is occupied by the stock room.

The company, of which Mr. S. Bergmann is president, is now approaching the close of the third year of its business as successor to the construction, wiring and supply department of the Edison Electric Illuminating Co. of New York, and it has control in this section of the Edison patented supplies. Business will be continued at 59 Duane street as a branch sales room for the convenience of customers and as a branch supply depot for other contractors, but the more central location of the new headquarters and the increased facilities consequent upon bringing together the executive, construction, manufacturing and selling forces in one building will enable the company to meet the demands of its rapidly increasing business more promptly and thoroughly than ever.

SPERRY ELECTRIC BRAKE.

The Sperry Electric Railway Company, of Cleveland, have received a flattering letter, which speaks for itself and also for the Sperry electric brake. The letter is in part as follows:

DEAR SIR:—

Your electric brake which is attached to our new cars with the new style Sperry controller is creating a furore in the electric railway world in Chicago. There isn't a day but that I have men connected with the electric railways here to examine your brake. I had a representative of the St. Paul and Minneapolis Street Railway Company here yesterday, and he was very anxious to learn what the cost of the brake would be and also how he could replace some of their old motors, with Sperry whaleback and electric brake.

I predict for the Sperry Company a very bright future.

Wishing you every success, I remain,

Yours, very truly,
CHICAGO GENERAL RAILWAY COMPANY.
(Signed) *W. B. Brennan*,
Sup't.

CHICAGO, ILLS., Jan. 17, '95.

THE ROGERS PRINTING TELEGRAPH.

Mr. Edward S. Norton, general manager, recently gave an exhibition of the Rogers system of printing telegraph, which he says is to be put in practical operation shortly between the cities of Washington and Baltimore. The exhibition took place at the office of the United States Postal Printing Telegraph Company, in the Kellogg building, Washington.

A typewriting machine, an electric machine for transmitting, a machine for receiving and a resistance representing a distance of 200 miles were utilized for the test. The message was first written on a typewriting machine with a punching machine attached. While the operator played on the keys of the typewriter, the puncher registered each letter in holes in a papertape arranged in a coil. The arrangement of the hole represents the letters.

When the message was finished the operator took off the perforated tape and placed it on the sending machine, provided with metallic fingers which transmitted telegraphically a complete duplication of the holes in the tape to the receiving machine at the other end of the wire. This machine worked synchronously with the sending machine, and registered the same letters in Roman characters at the same time on a sheet of paper. The message was printed and ready for delivery simultaneously with its sending.

It is claimed that 200 words a minute can be transmitted and printed by this system, and that even greater speed will be developed when certain improvements are made.

WATER POWER DEVELOPMENT AND ELECTRIC TRANSMISSION FOR ATLANTA, GA.

For several months past, negotiations have been in progress looking to the development of large water powers known to exist on the Chattahoochee River near the city of Atlanta, Ga. The matter has chiefly been carried forward by Mr. J. H. Vail, of New York City, and has now focalized in the organization of the Atlanta Electric Power Company, which concern will control an aggregate of about 30,000 H. P., divided between two powers; one half of the amount within nine miles of the city of Atlanta, and the remaining amount of 15,000 H. P., within thirteen miles from the same city. Both powers are derived from the rapids and shoals of the Chattahoochee River.

The first construction of dam and power house will be located on the property of Mr. A. E. Thornton, near Vinings Station, of the Western & Atlantic Railway. The surveys have been completed and the plans and specifications for the construction of the dam and power house and system of transmission are finished. The principal parties interested are: James Swan, president of the Atlanta National Bank, Atlanta, Ga.; A. E. Thornton, vice-president Atlanta National Bank, Atlanta, Ga.; H. R. Garden, of New York City; J. H. Vail, president of Electrical & Mechanical Engineering Company, of New York City; together with other prominent business men in the city of Atlanta, who are largely interested in the enterprise.

The entire construction has been placed in the hands of the

Electrical & Mechanical Engineering Company, No. 39 Cortlandt street, New York City. Ground will be broken at an early date and the work pushed forward rapidly. The development of this power will have great influence on the future prosperity of the city of Atlanta, affording the highest modern development of electric transmission and the distribution of power for large manufacturing purposes, as well as for arc and incandescent lighting, heating, and all allied industries. This project will be of lasting benefit to the city of Atlanta and to the South generally, and bids fair to make Atlanta the largest manufacturing centre in the southern states.

NEW STATION OF THE ALTOONA EDISON CO.

The Edison Electric Illuminating Co. of Altoona, have decided to erect a new station having a capacity of 1500 H. P. for arc and incandescent lighting and power distribution. They are now in the market for 1000 H. P. of boilers and 600 H. P. of engines, together with feeder wire and station accessories. Mr. E. B. Greene, is general manager of the company.

ELECTRIC RAILWAY WORK AT HERKIMER, N. Y.

Mr. J. Ledlie Hees, of Fonda, N. Y., is to be president of a new company which is consolidating the horse railroads of Herkimer, Mohawk, Ilion and Frankfort. The new system will be about six miles of trolley, with extensions. It is said that about $150,000 will be spent on the work. No apparatus has yet been selected. Mr. Hees is a well known man in state finance and politics.

FIXTURE CONTRACT AWARDED FOR ROCKFORD, ILL.

The Supervising Architect of the Treasury Department has awarded to Chas. W. Gindele, of Chicago, Ill., the contract for the interior finish, plumbing and electric light conduits for the U. S. post office building at Rockford, Ill., his bid being $18,610; time 5 months.

THE STANDARD UNDERGROUND CABLE COMPANY IN CHICAGO.

The Standard Underground Cable Company has just closed a contract with Mr. J. R. Wiley to represent them in the West with headquarters in the Rookery Building, Chicago. Mr. Wiley is well known in electrical circles, having been connected with electrical enterprises for many years including eight years in the Metropolitan Telephone & Telegraph Company as superintendent of private lines. He is a brother of Mr. Geo. L. Wiley who has represented the Standard Underground Cable Company in New York and the East for the past ten years. Mr. J. R. Wiley assumes the management of the Western Sales Department made vacant by the untimely death of the well known and popular Fred. E. Degenhardt, and was Mr. Degenhardt's personal friend. Mr. Wiley is a Western man and his family are Chicagoans.

PROTECTION FROM FIRE AT THE COTTON STATES AND INTERNATIONAL EXPOSITION.

Chief W. R. Joyner of the Atlanta Fire Department has secured free of charge a full equipment of fire apparatus, including the Gamewell fire alarm system, and the Gamewell auxiliary alarm for the use of the Cotton States and International Exposition. There will be equipments for three hose companies, three steamers, one hook and ladder truck, and two two-horse chemical engines. In addition, there will be three hundred or more three-gallon fire extinguishers, to be located in different buildings. As an extra precaution, eight 60-gallon, two-wheel fire extinguishers will be located in eight of the principal buildings. The Gamewell fire alarm will be up to date, with the latest improvements, and will be made especially efficient by the auxiliary system to be installed by the same company. This auxiliary alarm will include boxes distributed through the buildings, each containing a button under a glass. In case of fire, this button is pressed, and the exact location in the building is recorded at the fire department.

The tournament for volunteer fire companies, continues to grow in importance. Companies from remote parts of the United States have already enlisted, and this will stir up a vast amount of interest.

NEW YORK NOTES.

Mr. L. A. Ferguson, electrical engineer of the Chicago Edison Co., accompanied by Mr. Fred Sargent, of Sargent and Lundy, was in New York last week. The object of both gentlemen was to study the central station situation, and besides visiting the big plants here and in Boston, to secure data of use in their respective fields of work.

"Electric Power" has made its appearance this year in regular magazine form, with a page very similar to that of the leading reviews, which in high aim and useful contents it bravely emulates. It has a strong list of contributors, and its first issue in the new form gives promise of good reading all the year round. In addition to various articles by experts and authorities, it has a valuable and impartial index of current electrical literature.

PHILADELPHIA NOTES.

Mr. W. H. Beatty, who for several years has represented the Novelty Electric Co., of Philadelphia, and late of Hubley Mfg. Co. has opened an office at Room 916 Betz Bldg., Philadelphia. Mr. Beatty will represent several leading electrical supply manufacturers making the product of the Hubley Co. a specialty.

The Cutter Electric & Mfg. Co. have removed their factory and offices from 27 North 11th St. to 1112 Sansom street. The rapid growth in business of the Cutter company has compelled them to seek larger quarters for both their manufacturing and construction departments. They now occupy three floors in a large Sansom street factory—the first being divided into offices, stock room and shipping department while the two upper floors are well filled with machinery.

WESTERN NOTES.

The Electric Appliance Company report themselves pleased with the recent convention of the Northwestern Electrical Association held at Milwaukee and claim to have received some substantial returns in the way of orders, and meeting new trade which gives promise of future business. The numerous acquaintances made by its officers at conventions is a refutation of the idea that central station men are shy of the supply man.

Mr. W. T. M. Mottram has established himself as an electrical engineer at Dallas, Tex., where he has the State agency for the Interior Conduit & Insulation Co.; the Walker Mfg. Co.; the Helios Electric Co. and the Electric Storage Battery Co. He reports having visited lately the leading cities in the State, and having found encouraging business everywhere. He says: "Prospects are very bright and Texas is flourishing. One does not hear in this State continuous complaints of hard times."

Peoria, Ill.—Judge Worthington has appointed Frederick W. Horne of Chicago receiver of the Fort Clark St. Car Co. with a bond of $20,000. He was appointed on request and petition of Illinois Trust & Savings Bank as trustees representing the Street Railroad Illuminating Co. of Boston. The cause of the trouble is the failure of the company to meet the interest accruing on gold bonds amounting to $250,000, payable in fifteen years with 6% interest. The failure to pay the interest called for the forfeiture of the principal. The company will operate as usual. Mr. Horne was president of the company before. The Peoria General Electric Co. have about decided to increase the capacity of their plant by 1,000 horse-power, and to put in an equipment second to none.

The Central Electric Company, Chicago, have just issued another of their magnificent catalogues devoted to electric railway material. This with their illustrated general catalogue of electrical supplies and its comprehensive supplement of over one hundred pages, recently published, probably makes the most complete series of electrical supply catalogues ever issued. In their "Railway Material Catalogue" the company have only included such articles as bear the impress of the most practical and advanced thought and such action cannot be too highly commended. If more contractors, purchasing agents and others would realize the fact that in electric railway building, as in everything else, the best is none too good, dividends in many cases would be larger.

NEW ENGLAND NOTES.

The Plainville Electric Light & Power Co. of Plainville, Conn., has been organized with a capital stock of $10,000. It is controlled by the Central Railway & Electric Co., and the intention is to run lighting wires from the station at New Britain and do the Plainville lighting through that company.

The Farrel Foundry & Machine Co., of Ansonia, Conn., have decided to build a new roll and machine shop and have placed the contract for the building with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 104 ft. wide and 260 ft. long, constructed entirely of iron, brick and glass. The roof will be of copper.

The Berlin Iron Bridge Co., of East Berlin, Conn., have closed their purchasing agent's office in Philadelphia, and hereafter all purchases will be made from the office of the Company at East Berlin, Conn. Mr. W. E. Stearns who lately occupied the position of purchasing agent has severed his connection with the Company and accepted an important position with the Pennsylvania Steel Co.

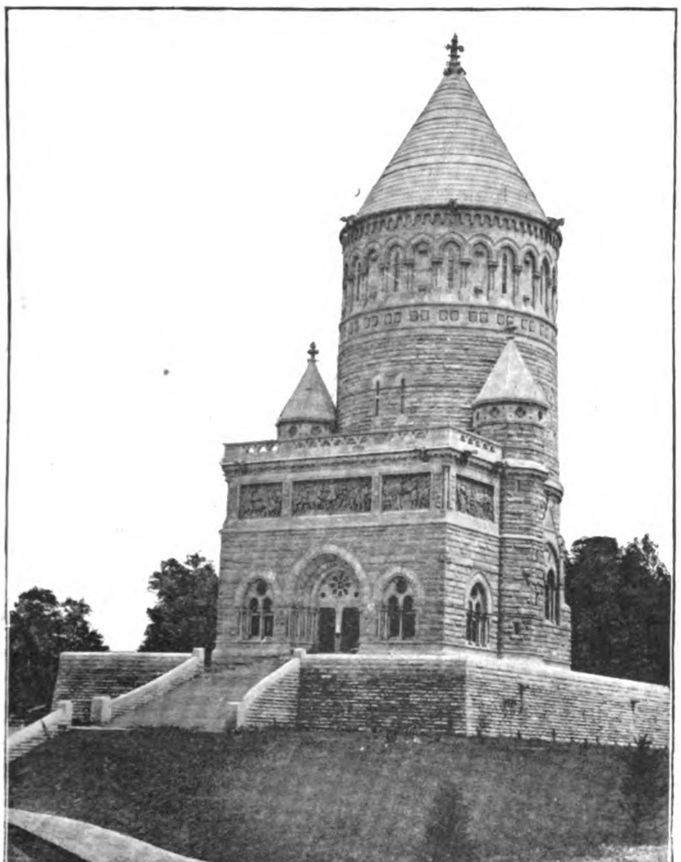
☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. FEBRUARY 20, 1895. No. 355.

CLEVELAND AS AN ELECTRICAL CENTRE.

THEY who visit Cleveland during the present week and take the opportunity to inspect some of its leading industries will not need to be told that the city remains, as of old, a great electrical centre. There have been, and are, other such centres in this country, but almost without exception they are identified electrically with the name and fame of some single great corporation. Cleveland on the contrary has not only been the home of a great industry famous the world over, but of late years has witnessed the upgrowth of various concerns of differing character, many of them important in product and scope of manufacture, and, when taken together, giving by their diversity and prosperity the best possible pledge of the continuance of Cleveland as an electrical centre through many years to come. Perhaps no other city in the world to-day offers quite so remarkable and miscellaneous a range of electrical products as Cleveland, from so many separate and distinct establishments. The list includes dynamos, motors, electroplating machines, railway generators, street railway motors and apparatus of all kinds; carbons; arc lamps, incandescent lamps; insulating material, electric cranes, storage batteries, instruments, switches, dynamo parts, battery material, carbon parts for telephone transmitters, electrical supplies, etc., etc. The total manufacturing capital of the city is about $75,000,000, of which at least a good tenth is embarked in electrical manufacturing enterprises, exclusive of local lighting and railway work.

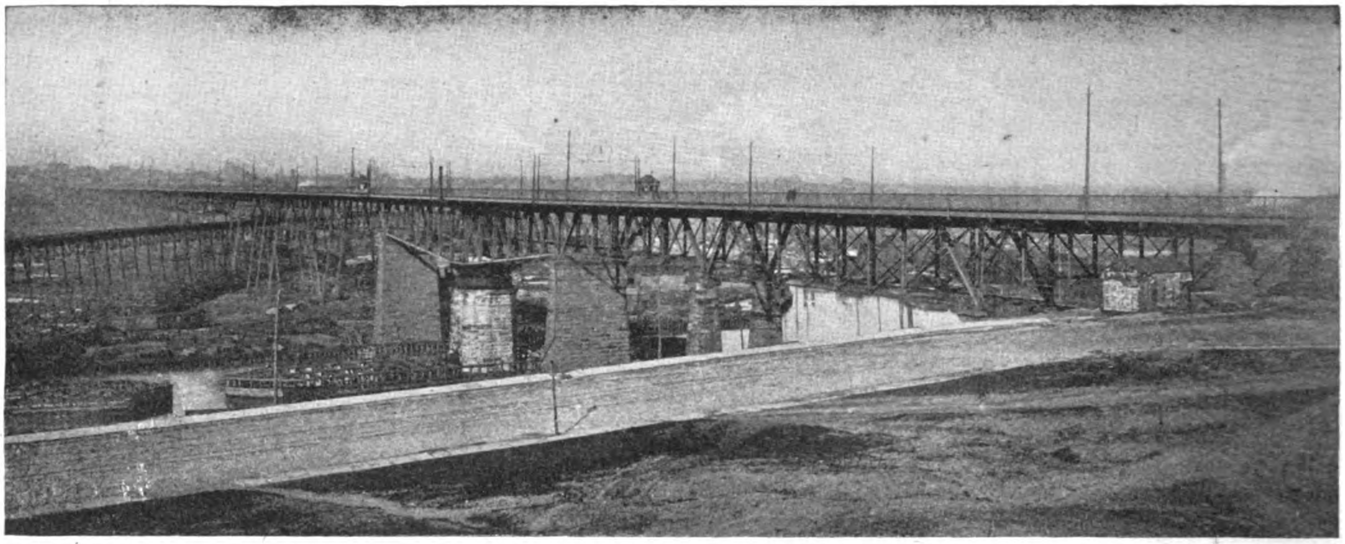


THE GARFIELD MONUMENT, CLEVELAND.

The two categories of work just named are illustrative of the curious manner in which, without any adequate explanation being apparent, one branch of electrical industry will sometimes outstrip another. As the birthplace of modern, practical arc lighting, it might be expected that the city would be ablaze with long lines of arcs on its fine thoroughfares. The very reverse is the case. Cleveland has but a miserable four or five hundred arcs for street lighting, and not until the present moment has it had a central station of which it could be proud. It may be hoped that the visit of the National Electric Light Association will do something to stimulate the citizens in the appreciation and encouragement of both arc and incandescent lighting. Meantime, the electric railway, thanks to the intelligent enterprise of local capital, has made Cleveland peculiarly its own, with the result that there is no city in the Union better supplied with street car service. The victory of the trolley is the more noticeable for the reason that the cable had already made a strong bid for exclusive occupancy. But Cleveland is a city of enormous distances, the city proper covering an area of no less than 26½ square miles, while thriving suburbs rise on every hand. Nothing but the trolley could subserve the needs of a population of 325,000 scattered over so large an area, and hence the existence of two extensive, well managed systems. Moreover, the demonstration with the trolley in Cleveland has been so brilliant and successful, that it has become the centre for a number of widely ramifying country lines; while one of the officials of the State of Ohio is distinguished by his persistent advocacy of the trolley for all the county roads, as a means of giving to the farmer and rural dweller all the facilities of cheap, swift and easy travel. It is needless to say that the electrical community of Cleveland is deeply interested in projects of this nature.

Outside of electricity, industries connected with iron, coal, oil, shipbuilding and lumber are those which chiefly engage the activities of the busy and pretty city on Lake Erie. It is evident that there must be much solid wealth in a city with a banking capital of nearly $25,000,000, and a total valuation of real and personal property reaching nearly $150,000,000. The fortunes held or invested in Cleveland have sprung largely from the courageous development of new industries; and in this respect the history of the Western Union Telegraph Co., and of Mr. J. H. Wade, is typical, giving Cleveland as high a place in the art of telegraphy as it has in that of electric light and power. It is likely that many of the delegates will take the opportunity to visit beautiful Wade Park.

There are many features of interest in Cleveland, among which may be mentioned the superb Euclid Avenue; the



THE CENTRAL VIADUCT, CLEVELAND, O., ACROSS THE CUYAHOGA RIVER.

fine Public Square with its memorials, statuary, and federal buildings; the Central and Superior Street viaducts, connecting the east and west sides of the city; the Lake View Cemetery containing the stately Garfield monument; and a large number of clubs, libraries, museums, office buildings and hotels. One of our illustrations shows the exterior of the Garfield Monument, on which $150,000 was spent; and another gives a view of the Central Viaduct, which is 4,000 feet long and crosses the winding Cuyahoga River at a height of 101 feet.

The articles succeeding this brief introduction enter more into detail as to the various electrical features and industries of the city that the National Electric Light Association has chosen to honor as its place of meeting on the occasion of its eighteenth convention, which also marks the beginning of its second decade.

CHARLES FRANCIS BRUSH.

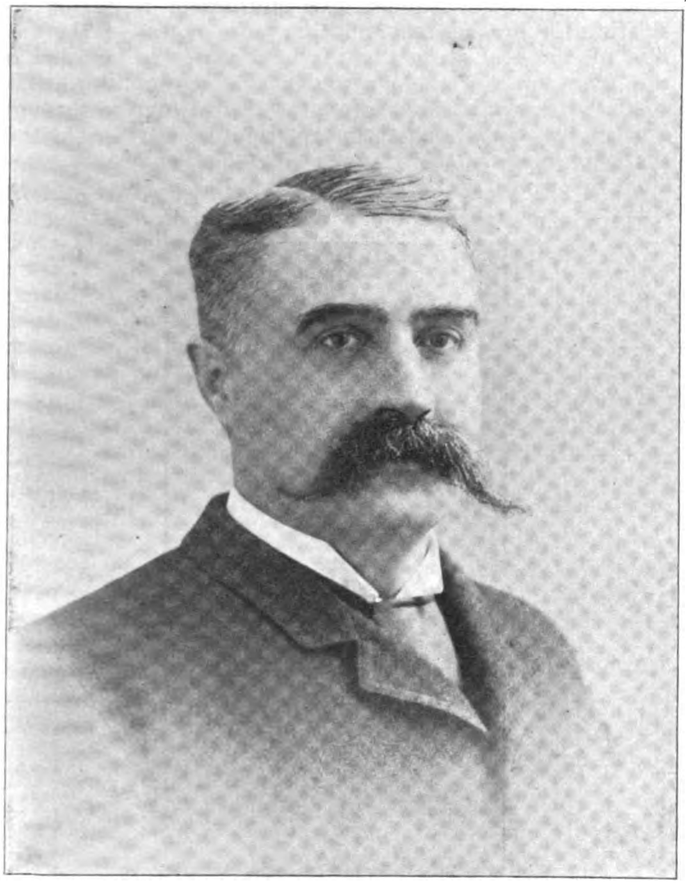
It is a curious and not altogether cheerful fact that there are very few fortunes of any magnitude that one can point to as having been made in the development of electric light and power. The capitalist may in some instances have fared very well, but there are barely half a dozen of the pioneer inventors who can be truthfully spoken of as rich men, despite their work in founding industries that now represent a capitalization of between $500,000,000 and $750,000,000 in merely the two departments of electric lighting and electric railway work. The creator of the Brush electric lighting system passes among his fellow citizens as fortunate and wealthy, but his reward even at the best has been but mediocre, and no one can grudge him the pleasant surroundings amid which he now spends his well-earned leisure, a large part of which is still devoted to advanced investigation and research in electricity and mechanics.

Of purely English descent, like many other leading American electricians, Mr. Brush was born on March 17, 1849, in Euclid Township, near Cleveland. His early years were spent on his father's farm and in attendance at the district school at Wickliffe, O. At a very early age Mr. Brush gave evidence of great inventive bent of mind. After attending for a season the Shaw Academy, at Collamere, O., he entered the Cleveland High School, where his experiments in physics and chemistry attracted great attention. Some of his later inventions were conceived and partially completed while he was still a student at the High School. During his senior year the chemical and physical apparatus of the laboratory of the school was placed under his charge. In this year Mr. Brush also constructed an electric motor having its field magnets as well as its armature excited by the electric current. Here he also constructed his first electric arc lamp.

In September, 1867, Mr. Brush entered the Engineering Department of the University of Michigan, graduating with the degree of M. E in 1869, a year in advance of his class. After a short business career, Mr. Brush resumed his electrical investigations with results which fairly startled the scientific world. In 1876 he completed his famous dynamo-electric machine. The following year he carried off the honors of the Franklin Institute at Philadelphia for his commercial arc lamp and dynamo-electric machine. The invention of the modern Brush series arc lamp followed, and then began an outburst of activity in the domain of arc lighting that has rarely been equalled in any field. This lamp, it will be remembered, had a regulating shunt of high resistance, enabling long circuits crowded with lamps to be successfully run from one machine, so that the failure of one lamp from any cause did not interrupt the burning of the others or interfere with the output of current by the dynamo in the station. From about this period, which witnessed the formation of the first central station companies, date also the Brush copper plated carbons; the perfected automatic cut out for arc lamps; the double carbon lamp; the Brush compound wound dynamo for incandescent lighting; the Brush storage battery and a number of other inventions of a distinctly novel and valuable nature. It is unnecessary to say that his numerous patents have from first to last been involved in fierce litigation; but it may be remarked that he has had far better luck in the courts than some of his distinguished rivals and co-workers. His inventions have been taken up more eagerly abroad even than at home, and the Brush arc system is probably the only one that has yet made a triumphant circuit around the globe. It flourishes in hardy vigor everywhere.

Besides holding diplomas from his alma mater, Mr. Brush is a Ph. D. of the Western Reserve University. In 1881, he was made a Chevalier of the Legion of Honor by the French Government in connection with the Electrical Exposition at Paris. He was one of the earliest members and officers of the American Institute of Electrical Engineers, and is a Fellow of the American Association for the Advancement of Science.

Having secured wealth from his inventions and patents, Mr. Brush has placed a large portion of it in solid investments that do credit to his business acumen. He has also expended some of it on one of the most luxurious and artistic homes in Cleveland, built from his plans, and illustrating in many unexpected ways his scientific exactness



CHARLES FRANCIS BRUSH.

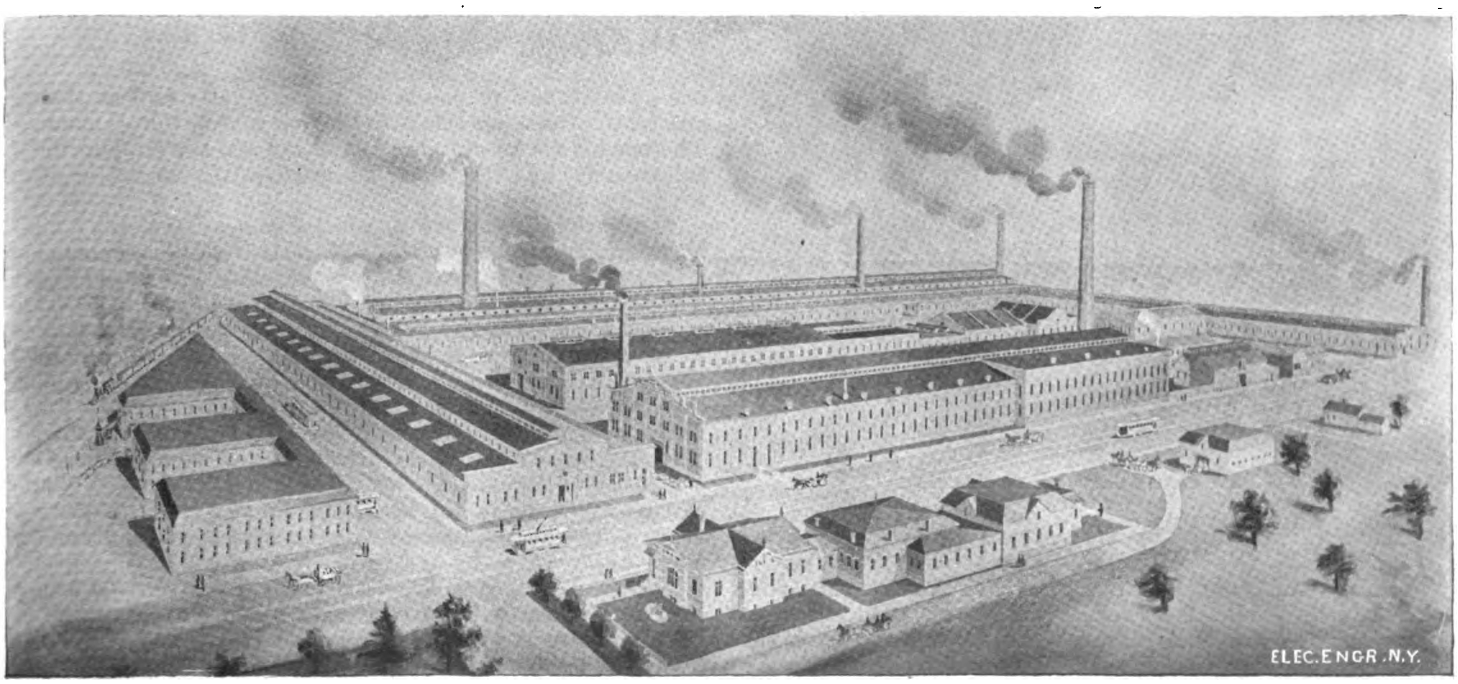
and attention to detail. It is lighted by several hundred incandescent lamps, and within the private park of six or seven acres stands a huge windmill which for years past has driven a dynamo and storage battery plant for furnishing the current.

Mr. Brush is a man whose physique fully equals his mental capacity, for he stands six feet two in his stocking feet, and is straight and broad shouldered to match. He is of rather retiring disposition, shunning print and interviews, and rarely rising to make a remark except in the form of a broad patent on some new invention. In no sense can he be called a popular man; nor can it be said that he has ever sought or won a personal following, preferring rather the close friendship of one or two intimates. But his reticence leaves him entitled to the respect and esteem of the electrical community; and it is not the least striking thing about his career that his prophetic sense of the requirements of the art, leading him in the direction of high tension work puts him now, nearly a quarter of a century later, in close relation to the dominant tendencies and developments which promise rich fruition in the future.

THE BRUSH ELECTRIC CO.

Reference is made elsewhere in this issue to the pioneer work of Mr. Charles F. Brush, who is fully entitled to the credit of being the chief founder of the industry and art of arc lighting in America. The company which took up the manufacture of his apparatus was the old Telegraph Supply Co., of Cleveland, founded in 1876. In 1880, it became the Brush Electric Co., with a capital of $3,000,000, and although the last few years have seen it become a part of the vast congeries known as the General Electric Co., it continues a separate and prosperous existence, putting forth apparatus that still bears the time honored name and which has never been more efficient and successful than it is to-day. For well-nigh twenty years the Brush works in Cleveland have been a centre of deep interest to every electrician, and for aught we can see to the contrary they will claim their share of attention for at least twenty years to come. It is true that Mr. Stockly and Mr. Brush are no longer there, but younger men with new ambitions have come to the front, and the old place still hums with the varied sounds of busy electrical industries.

A view is here shown of the Brush factory, where several hundred hands are employed. An interesting feature of the principal machine shop is an early electric crane operated by motors of the standard Brush type. This crane was built by the Morgan Engineering Co., of Alliance, O., and has a capacity of 10 tons. It is handled by three Brush slow speed motors, one of 10 H. P. and two

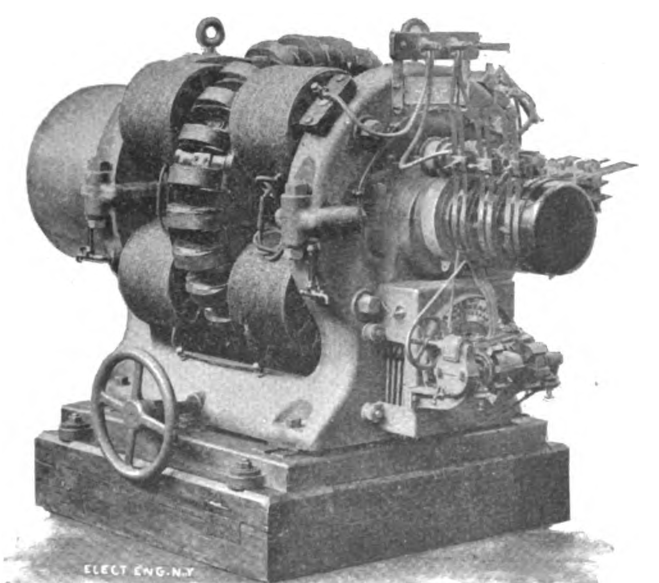


THE WORKS OF THE BRUSH ELECTRIC CO., CLEVELAND, O.

of 5 H. P. each, specially designed in relation to the work. The Brush shops as a whole cover about seven acres, and the work done in them includes also that for the production of Brush-Swan incandescent lamps and of Sperry railway motors, controllers and magnetic brakes. The main buildings are: Principal machine shop, 265 feet by 122; cathedral shop, 200 by 100; carbon factory, 600 by 62; pattern room and carpenter shop, 120 by 70; lumber room, 80 by 50; power building, 120 by 110.

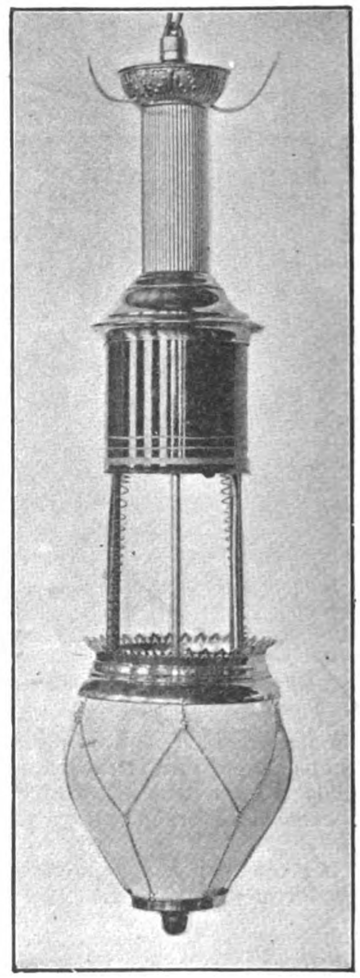
As is well known, the Brush Co. builds dynamos, motors, electroplating machines, arc lamps and much other apparatus. It will suffice here in illustration of its product to illustrate the latest form of its world famous arc lighting dynamo. The machine here seen is of 100 lights capacity, at 9.6 amperes. It weighs 7,300 pounds. The 125 light machine runs at 500 revolutions per minute and its rated capacity is 125 50 volt, 9.6 ampere arc lamps, or 60 K. W. It will, however, give 6,700 or 6,800 volts without undue heating. Its weight, including sub-base, pulley and regulator, is exactly 5 tons, fully 25 per cent. less, it is said, than any other machine of equal output and speed in the market to-day. The frame proper is made of the best grade of soft gray iron and is cast in three pieces. The two upper caps can be readily removed, giving free access to the armature which can be taken out and replaced in a very few minutes in case of necessity. The journals are self-oiling and self-aligning with gauged glasses, so that the amount of oil in the well can always be ascertained at a glance. The field magnet cores are hammered steel very low in carbon and showing very high permeability. The pole shoes are steel castings tapered at the tips to prevent excessive heating due to eddy currents. No. 8 wire is used in the field which is two sizes larger than on the majority of arc dynamos of other makes. The current per square inch is only 746 amperes; consequently the temperature rises but little, even after a 24 hours' run. The armature is the well known Brush type, the only difference being that on account of the machine being four pole, four bobbins are connected in series instead of two.

In the commutator there are three distinct rings each



NEW BRUSH ARC LIGHT MACHINE.

one of which is built up in sections of thoroughly dried apple wood filled with boiled linseed oil. Over this is forced a mica ring $\frac{1}{16}$ of an inch thick and on the sides mica discs protect the wood from the arc. On the mica are mounted the brass segments and on these in turn is the copper. Lignum vitae blocks $2\frac{3}{4}$ in. long serve for insulating pieces between the segments. The brushes are of the tangential type the same as are used in connection with all Brush open coil dyamos. An automatic regulator for shifting the brushes and shunting more or less of the current for the field magnet as the load varies is fastened to the front of the machine under the commutator. The small shaft, which passes across the front is driven through a worm by a small belt from the armature shaft. On this shaft are mounted two magnetic clutches which are regulated by two relays on the wall controller. The electrical



NEW BRUSH CONSTANT POTENTIAL ARC LAMP.

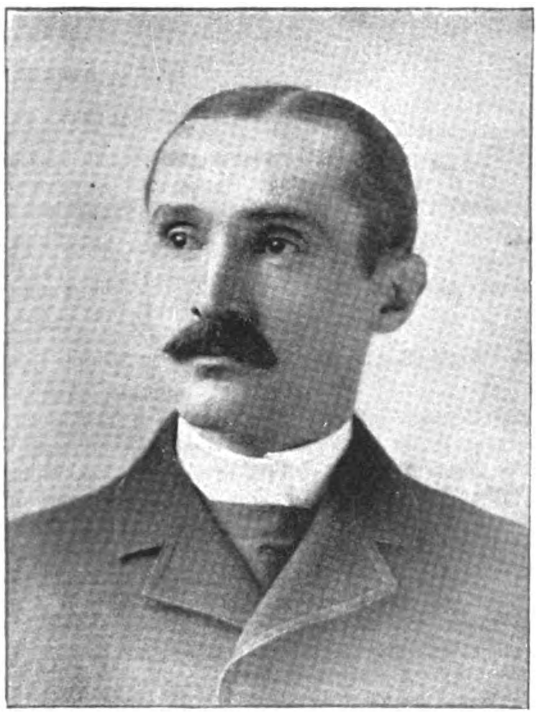
energy consumed in operating the regulator is less than one-tenth of one per cent. of the output of the dynamo. The machine is absolutely automatic from one lamp to the full capacity and the whole load may be thrown on or off with impunity.

The various forms of Brush arc lamps have also long been familiar to the public. Before 1881 there were over 6,000 in use, and no year has gone by since without a large increase, so that the number burning to-day may easily reach 150,000. The later types known as the Brush-Adams were illustrated in THE ELECTRICAL ENGINEER in its World's Fair articles ; and we now have the pleasure of showing a new form for incandescent circuits due to the fertile genius of Mr. Adams.

It may be added that the Brush carbon factory turned out 5,000,000 carbons in 1883, and 26,000,000 in 1893. The Brush-Swan lamp factory has long pursued the even tenor of its quiet way, producing some thousands of incandescent lamps every week.

The active management of this representative American electrical industry to-day is in the hands of Mr. S. M. Hamill, whose strenuous devotion to its welfare is manifested in a great many ways. Mr. Hamill is both second vice-president and general manager. He graduated with the degree of B. A. from Princeton in the term of 1880,

and since that time has received the degree of M. A. After leaving College he taught for three years in the Lawrenceville school, N. J., during a portion of which time he studied law. Having a desire for active business pursuits, and determined to go to work, he secured, in 1884, a position as clerk in the freight department of the Chicago, Burlington & Quincy Railway Co., and subsequently became private secretary to the agent, clerk in the paymaster's office, and in the first vice-president's office in Chicago. In 1886 he was in charge of the large grain elevators owned by the Chicago, Burlington & Quincy Railway Co, in Peoria, Ill., from which place he went to Cleveland to accept the position of assistant secretary of the Brush Electric Co. Three years later he was elected secretary and moved to New York City where he became well-known from his work as manager also of the general Eastern business of the company. He was next elected a director, secretary and general manager. Mr. Hamill is also president, secretary or director in a number of local electric light companies, and is actively identified with



S. M. HAMILL.

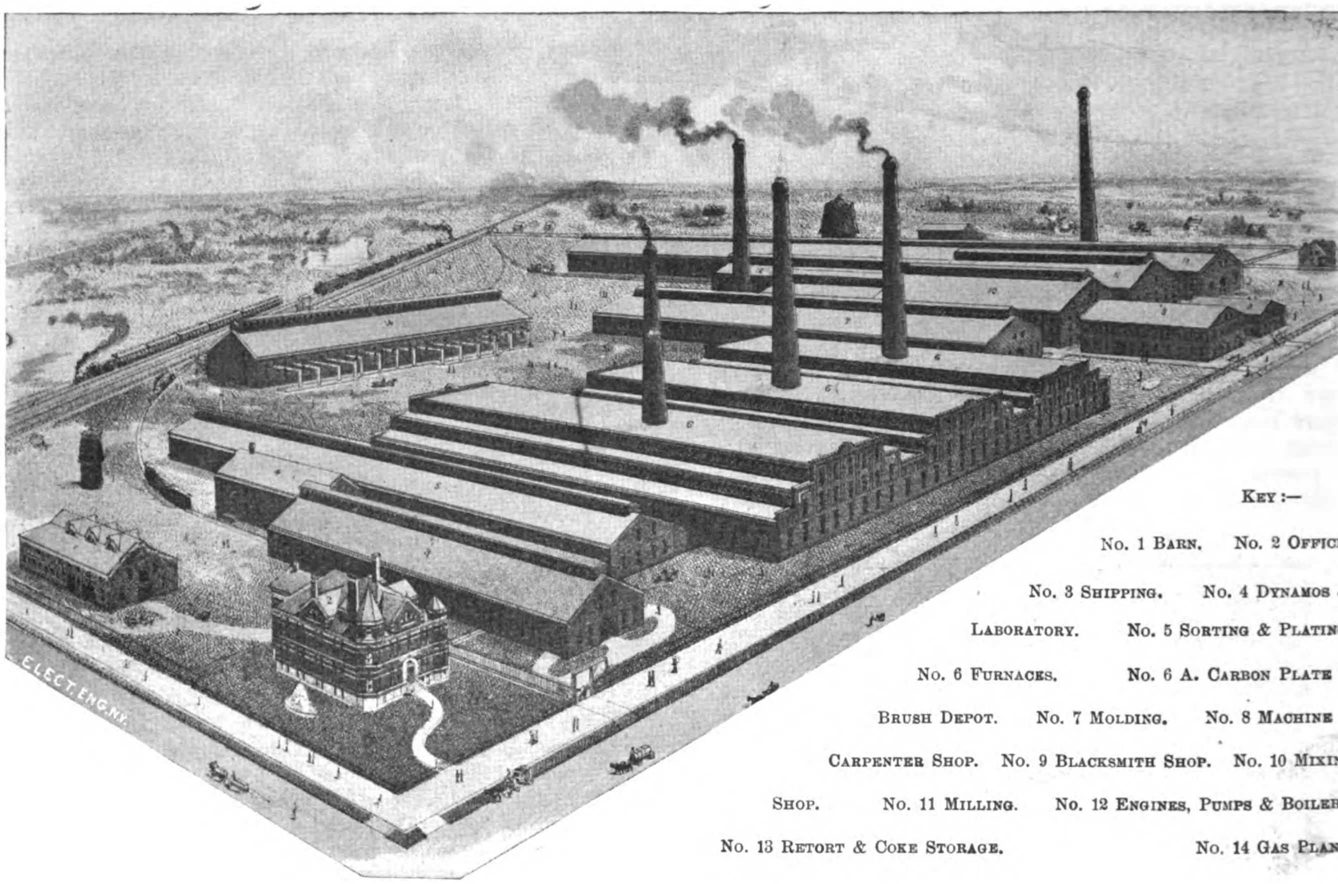
many social, scientific and college associations. His aides are Mr. C. W. Phipps, superintendent of the works; Mr. C. N. Black, the electrician, and Mr. T. E. Adams, the head of the arc lamp department. Mr. A. D. Dorman is at the head of the office staff. Of the 600 men in and around the works a large number have been in the Brush employ for years. Many of the foremen have had long terms of honorable service. For example, Mr. J. W. Adams of the dynamo assembling department has a record of 16 years; Mr. J. Maskel, brass department, 14; Mr. F. Schneider, lathe, planing, etc., department, 14; Mr. P. T. Kinney, sheet and metal department, 13. It is needless to say that a notable esprit de corps reigns throughout the establishment, and that the men take a great pride in the quality of their work, and in the general excellence of the output of the old factory, which so many of them have helped to give its high name and reputation.

Besides the officers already named, the company has the following: W. H. Lawrence, president; C. A. Coffin, first vice-president; B. F. Miles, treasurer; W. B. Bolton, general counsel; A. H. Hough, secretary; L. H. Rogers, assistant general manager.

THE NATIONAL CARBON CO.

It is safe to say that had arc light carbons remained at the price of $70 or $80 per thousand as in 1882-3, the National Electric Light Association would not have had a very large field from which to recruit its membership. But with prices around $10 or $12, it does not lie in anybody's power to say that this special product has not been duly cheapened. To define the exact stages by which the lower range of value has been reached would not be easy, but, as the raw materials have remained pretty much the same, it must be obvious that the result is due chiefly to two factors, namely, ingenuity in the reduction of the processes or handlings required for the manufacture of carbons; and production on the largest possible scale. These are the two ideas at which Mr. W. H. Lawrence, president of the National Carbon Co. has hammered ever since he and Mr. Brush experimented together in 1877 on crude substances for arc carbons. French carbons in those days cost about 40 cents apiece, and even if city arc lighting was to be done at the rate of a dollar per lamp per night, a cheaper carbon was necessary if money was to be made. In petroleum coke, Messrs. Brush and Lawrence found one desideratum; in coal tar pitch, as the binding material, was another; and in various other details, such as plating, came improvements and perfections such as give us the modern carbon burning nightly in half a million arcs all over this continent. At this hour, however, just as seventeen years ago, Mr. Lawrence may be found immersed in experiments and carbon dust, enveloped in a halo of flying particles and of cheery enthusiasm over some new method of at once improving and cheapening the product.

The members of the National Electric Light Association will have an opportunity for themselves of seeing carbons made at the factory of the National Carbon Co. of which a view is here given. The factory is just about finished and, when it is running full, it has the magnificent capacity of 200,000,000 carbons a year. For ordinary carbons, the petroleum coke is crushed, heated in retorts for several hours, ground to a fine flour, bolted and delivered to a pan for association with the binding material. The pitch and the carbon flour in the pan are kept warm and in constant agitation, to encourage their union, and at the end of a certain time, up to an hour, the mixture is cooled; when the resultant is a kind of black pebble and sand. This is again crushed, ground and bolted, and a flour of smooth uniform grain is the result. The carbon is now ready for molding, an operation performed by men who have steel molds corresponding, when laid together, to the shape and length of the pencil to be made. Into these steel frames the carbon is carefully deposited. It is then slowly heated, becoming a paste. At the right moment, the mold is removed from the source of heat and placed under a hydraulic press. After the gentle squeezing of a few hundred tons' pressure, the molds are taken out, reopened at the bench and the plaque of carbons lifted off. As these plaques cool, each carbon is snapped off from its adjoining fellows, and deprived of its little wing or flange, becoming thus the circular carbon that we see it, with the ends slightly rounded. The carbons are now ready for baking, a process which drives off all volatile matter, and converts the heavy, dull, but brittle stick into the hard springlike, metallic-ringing bar that makes one think sometimes that he has got hold of a new grade of steel. Carbons were formerly baked on the retail plan, but now they are placed by wholesale in huge furnaces, where for days together they are subjected to an intense heat, the carbons themselves reaching a temperature up to 2,000° and 3,000° Fah. At the National Carbon factory, fuel or producer gas, made in a separate building is piped to the vast floor on which the furnaces are situated; and there, by ingenious methods devised by Mr. Lawrence, is made to do its baking work with the highest economy and efficiency. It is most interesting to look into one of the



OFFICES AND WORKS OF THE NATIONAL CARBON COMPANY, CLEVELAND, WITH 26 ACRES OF FLOOR SPACE UNDER ROOF.

furnaces at the height of the process, and see the combustion going on within at the whitest of heat.

After leaving the furnace, the carbons are sorted by means of steel plates, becoming "firsts" or "seconds," etc., according to the straightness. They are then swiftly plated, and are ready for packing, which is done by putting them in "blocks of five" and the blocks into packages of twenty-five, in which condition most of our readers make their acquaintance. The less perfect carbons are sold as "seconds," cut into short lengths, or thrown out. The boxes of regular, good carbons, each containing 1,000 reach the railroad platform of the shipping department, up to which the cars are backed daily for their load.

We have spoken hitherto of molded carbons, but there are, of course, forced carbons, which go through practically the same treatment, except that they are forced through the die of a hydraulic press and are cut to the desired length as they emerge. These carbons are also made with a softer core, if ordered, the object being to centre the burning arc in the lamp. The nature of the cores is like many other things kept a secret, but as the leading lead pencil manufacturers of Europe make a specialty of cored carbons, our readers are probably able to draw a pretty correct inference on the subject. The forced carbons are used specially in lamps on alternating circuits or those running on constant potential, multiple circuits; while molded carbons are in universal use for the straight series arc lamp.

The National Carbon Co. make besides arc lamp carbons, a vast variety of carbon specialties for batteries and other purposes, and of late have experienced a brisk demand for carbon buttons for battery telephone transmitters. The growing use of carbon brushes on dynamos and motors has also to be attended to; so that there is an incessant call upon the ingenuity of a large electrical and mechanical staff, under Mr. Lawrence's direct supervision.

Adjoining the factory, is a handsome office building, replete with every comfort and convenience for the employees and the respective chiefs of departments. Around the factory are located also stabling, fire apparatus, store rooms and other adjuncts. Everything has been systematically planned and most admirably carried out. Mr. Washington H. Lawrence, as president of the National Carbon Co. the Sperry Electric Railway Co., the Brush Electric Co., and its subordinate branches, occupies naturally a prominent position among Cleveland manufacturers. He was born in Olmstead, Cuyahoga County, Ohio, January 17th, 1840, and enjoys the advantages of a descent from that New England blood which has carried the fame of American manufactures and inventions around the world. His father was Joel B. Lawrence, of Pepperell, Mass. who with his cousins, Amos and Abbott Lawrence, were descendants of John Lawrence, one of the early settlers of the Massachusetts Bay Colony, having landed in 1635 and settling in Wolverton, Mass. Left an orphan at 13 years of age, Mr. Lawrence began life as a clerk at Berea, O., where he continued his studies which had been begun in the common schools of Olmstead. He pursued at the same time a course of study at Baldwin University, and gained both a college as well as a business education by reserving a portion of his time to himself. When 19 years of age, Mr. John Baldwin associated his son Milton with Mr. Lawrence in the management of large milling and real estate properties in Kansas. Milton Baldwin's death, before the enterprise was fully inaugurated, left the entire care of the properties upon Mr. Lawrence's shoulders.

In the latter part of 1859 Mr. Lawrence concluded his connection with Mr. Baldwin and desiring to be his own master, engaged in business with his brother at Hannibal, Mo. He returned to Olmstead late in 1861 to manage the family property there, and in 1864 removed to Cleveland, where he became associated with Messrs. N. S. C. Perkins and W. A. Mack in the manufacture of the Domestic Sewing Machine. This business proved very successful,

as Mr. Lawrence succeeded in triumphing over the sewing machine combination in all their patent litigations, and ultimately sold his interest to his associates. He had charge of the sale of the Howe Sewing Machine Co., his territory including five states, and was at the same time engaged in manufacturing bolts at Elyria, Ohio, in what is now known as the Cleveland Screw & Tap Co. He disposed of all these interests in 1874 and noticing the great importance of electricity in commercial pursuits, he became in that year a large stockholder in the old Telegraph Supply Co., and retained his interests through its various changes until it was finally merged into what is now the Brush Electric Co. Mr. Lawrence was associated with Mr. Charles F. Brush at the inception of the Brush Electric Co., furnishing a large portion of the original investment, and even in the darkest hours remaining firm in his conviction of the ultimate success of the undertaking. The same pluck and energy that had characterized his early connection during the dark days of the Company was continued until the Brush Co. had a capital of $3,000,000, and as its general manager, Mr. Lawrence had charge of the largest electrical manufacturing establishment in the world.

W. H. Lawrence.

After twenty years of most exacting business life, Mr. Lawrence in 1882, resolved to take a much needed rest. Severing his connection with the company, and selling or exchanging the greater part of his interest, he invested largely in real estate properties in Cleveland and elsewhere, and for several years devoted his leisure to its management. Although possessed of real estate interests large enough to require all the time of most men, he was still unable to resist the charms of active manufacturing management, and in 1886 after carefully looking over the field, he decided to turn his attention to the manufacture of electric light carbons, as this product was now used in every part of the globe in connection with arc lighting. Early in the history of the Brush Electric Co. he had, as already stated, spent much time in their carbon department, and now returned to it with renewed zest, and became associated with W. W. Masters in the manufacture of carbons at what is now the Willson Avenue factory of the National Carbon Co. Mr. Masters through failing health was anxious to retire, and Mr. Lawrence with his associates, Messrs. Myron T. Herrick, James Parmalee, and Webb C. Hayes, became the owners of the entire business, under the name of the National Carbon Co. After four years of very successful business it was found necessary to largely increase the capacity, and in 1891 the company purchased 115 acres adjoining the Lake Shore Railway Co.'s right of way in the hamlet of Lakewood, just west of what is now the city limits of Cleveland. On this tract of land has since been erected the largest carbon factory in the world, as shown in the accompanying cut.

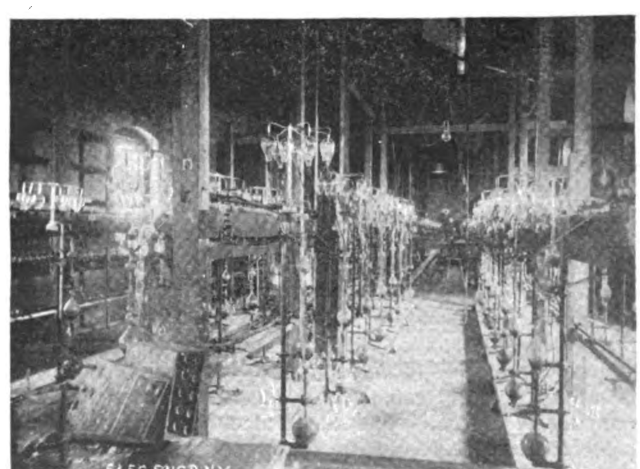
Mr. Lawrence has not only been a manufacturer in the sense of an organizer and manager, but he has also shown great inventive capacity, and a genius for constructing machinery adapted to factory use. The present factory just completed displays in a marked degree the improvements and inventions that have been made by him in this industry in the past few years. The processes of manufacture have been radically changed and the improvement is very marked, when the factories of five years ago are taken into consideration.

Mr. Lawrence is still the embodiment of indomitable energy, perseverance and ability, and in addition to the task of constructing the present large factory, as well as supplying carbons from the old factories, he has within the last year taken upon himself the presidency and management of his old company, the Brush Electric Co., as well as that of the Sperry Electric Railway Company, which in a marked degree shows the latest improvements in electrical equipment for street-car purposes.

In the management and active direction of the affairs of the company, Mr. Lawrence, as president, is assisted by Mr. B. F. Miles, vice-president; Webb C. Hayes, treasurer, and H. E Hackenburg, secretary.

THE BUCKEYE ELECTRIC CO.

Named from the popular title of the state in which it has its home, the Buckeye Electric Co. was incorporated in 1890, with a capital stock of $100,000, and was established as an addition to the electrical concerns of Cleveland, its business being the manufacture of incandescent lamps. The company is just five years old this week, and has experienced a constant growth. Its original factory was modest in size, being a frame structure only 50 feet square, two stories high, with a small addition in the rear for boiler and engine room; yet with a view more to the probable rise in value of the real estate, than their immediate necessities or hopes of future enlargement, a large plot of ground was fortunately secured. The building was completed, the apparatus purchased and put in place, but many unforeseen difficulties presented themselves, and it was October before the first production of the young company was placed on the market. Success was not immediate or marked. The filament adopted was one of well known and ordinary type, and though the business was self supporting, the output was very small and the profits yet to be, but in the winter of 1890 and 1891 there was brought to the attention of the Company a process of manufacture which produced a filament infinitely superior in their judgment to anything in use for this purpose in this country. This was owned by parties in Europe, and the negotiations resulted in the purchase by the Buckeye Co., of the sole and exclusive right to its use in the United States. The results were immediate and surprising. The trade and the consumer at once appreciated its value, and the "Buckeye" lamp rose quickly to prominence; the demand increased so rapidly, that the little factory, though



PUMP ROOM OF THE BUCKEYE ELECTRIC CO., CLEVELAND, O.

worked day and night, was entirely unable to produce an output commensurate with the sales. The result was that the management decided at once to increase facilities, and a substantial brick building was erected, and fitted up with new and improved apparatus, and the production increased to 2500 per day. The new factory was occupied on January, 1st, 1892. From this time forward the success and progress of the Company have been continuous, with the exception of the legal troubles which assailed it in common with most others in the same line of business. But though stopped by legal process for a time, they were eventually sustained by the Courts, and in the summer of 1894 a second and still larger addition to their plant became necessary, and their present factory was erected, as shown in the accompanying cut.

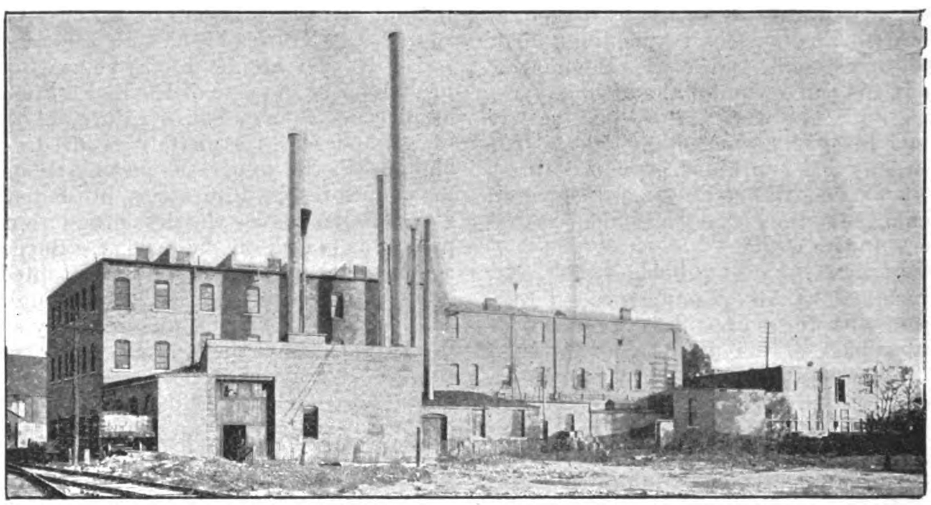
This factory which is situated on Broadway, Cleveland, O. consists of the old building, which is now used as a store room and warehouse, the main brick building three stories high occupying a space 170 ft. deep with 60 ft. frontage and the commodious engine and boiler rooms. In the engine room the machinery is driven by a 100 H. P. Cooper-Corliss and a 150 H. P. Bates-Corliss engine, together with a 75 H. P. New York Safety. Steam is generated by a 150 H. P. Stirling water tube boiler, a 100 H. P. Babcock & Wilcox, and a 100 H. P. tubular boiler. Current is generated from no fewer than ten dynamos, of various sizes and voltages, among which Brush, C. & C. and Excelsior machines are included. These are all belted to Brightman's friction clutches and shafting.

On the third floor of the main building some seventy or eighty girls are employed in winding, preparing, mounting and treating filaments, and for these processes some very ingenious and elaborate apparatus has been installed. This department being devoted to work of the greatest delicacy and refinement, requires the closest watching and supervision. The superintendent has located his office here, together with a commodious laboratory, where experimental work is being continually carried on. As is well known, the filament process used by The Buckeye Electric Co., is a specialty of the firm.

The chemical organic material from which the filament is prepared, previous to winding and carbonizing in a moist state appears as a transparent gelatinous thread. After the drying, it has the appearance of horse hair or catgut, being colorless, perfectly round in section, homogeneous in structure and uniform throughout its length. These characteristics are obviously of great value in evolving a filament of constant durability. Impurities in the original thread being visible, are easily removed, previous to carbonization. The thread-like material is wound on carbon blocks or forms, to give it the required shape, and carbonized in a specially designed furnace.

After carbonizing, the filaments present a surprisingly beautiful appearance, not unlike spun black glass. The material, although chemically differing but little from wood charcoal, is almost steel-like in elasticity, and its hardness and glossy surface give it quite a vitreous character. The fact will at once be appreciated, that a filament possessing these properties is peculiarly suitable for withstanding the great strain which it necessarily undergoes, when subjected to incandescence temperature for some 1500 hours. It might also be mentioned here, that the great elasticity of the carbon is a great virtue when used in a railroad lamp, and the Buckeye Electric Company claim that their filament has never been known to break at the point where it is anchored down, a process that is absolutely necessary in street car lamps, but a constant source of trouble with many makes of filaments.

On this same floor in the fore part of the building is situated the glass blowing department, where some fifty girls are engaged in the processes of tubulating, wire burning and stem making, for which latter work a very effective method of spinning or reaming out glass tube is adopted. Here also is arranged the sealing-in department, where girls are engaged in sealing the filaments into the glass bulbs by the aid of original machines, the invention of two of the technical staff of the Company.



New Incandescent Lamp Factory of the Buckeye Electric Company.

On the second floor is located a capacious machine shop, well stocked with the ordinary tools, including some half dozen lathes of various kinds, drill press, etc. On this floor are also located the capping and testing departments, the latter including both vacuum and photometer testing; also the final burning of the lamps and their inspection previous to shipment. For the photometer testing, five Queen photometers fitted with Weston voltmeters and ammeters are installed.

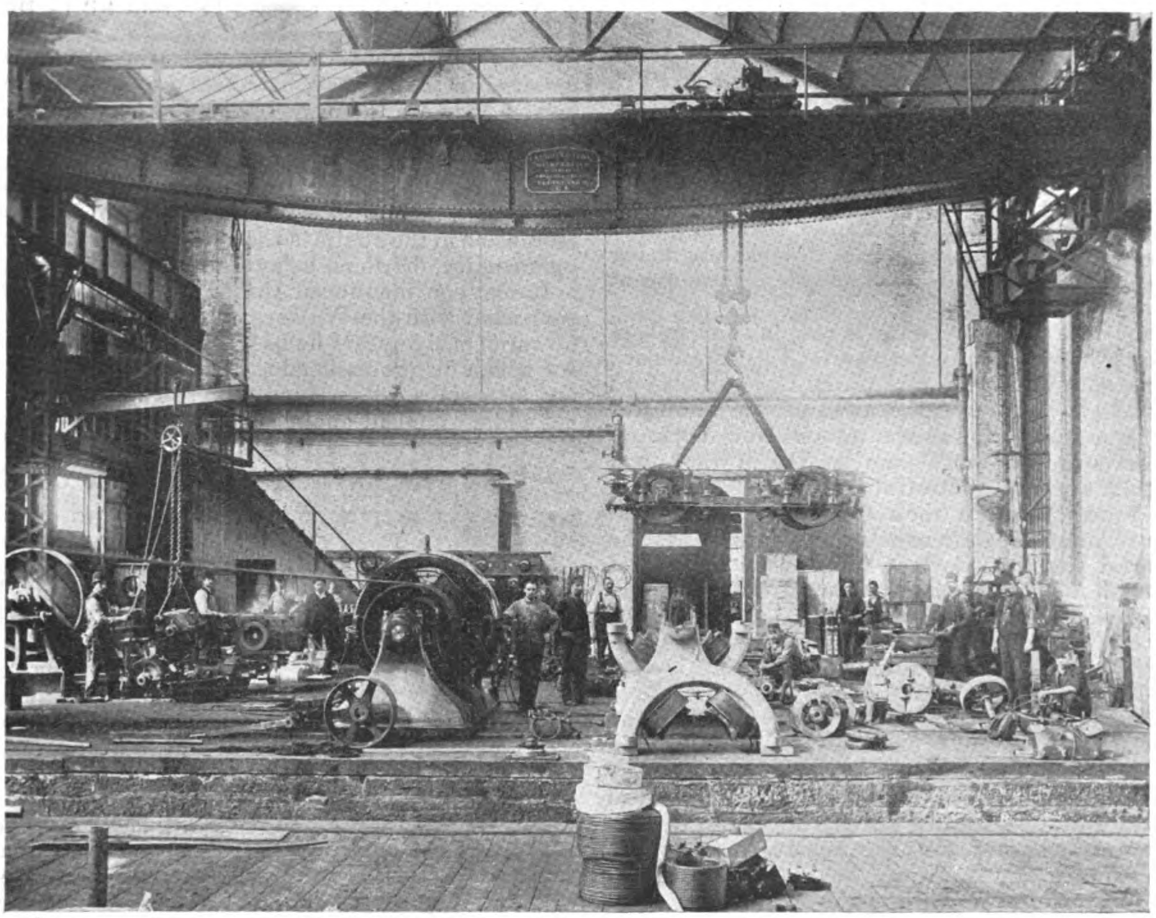
On the ground floor is the pumping or exhausting shop. Here are installed about 200 quick acting mercury pumps of a special design, and requiring in all some five tons of quicksilver.

The present output of the factory is between five thousand and six thousand lamps per diem, and for this purpose upwards of two hundred and fifty men, boys and girls are continually employed In this factory very great care is taken to see that no faulty material is turned out, and that all manipulation is as perfect as possible. No small effort is also made to make the "Buckeye" lamps not only efficient, and long lived, but also things of beauty. All the filaments are artistically shaped, coiled and centered

J. Potter.

in the bulbs, and the latter are of uniform size and design.

The paid-in capital of the Company is now $300,000, and though their plant has been twice rebuilt and enlarged, the indications are that the present facilities will be entirely inadequate for the demands of their rapidly increasing business, and that a further and still larger addition to the plant herein described will be a necessity of the near future. The officers of the Company are J. Potter, President, O. M. Stafford, Vice President, Chas. H. Rockwell, Secretary and Treasurer, and Arnold Spiller, Supt., the main offices being located at No. 401-405 Cuyahoga Building, Cleveland, O. Mr. Potter, of whom we give a portrait, is well known not only from his presidency of the Buckeye Co. but by his active association with earlier and pioneer enterprises in the electrical field. He is an



INTERIOR OF THE WALKER CO.'S WORKS, CLEVELAND.

M. A. of Princeton, and was a member of the Princeton scientific expedition of 1877. In 1881, he became associated with the Brush interests, and was most successful in developing electricity in the Far East with Brush apparatus. From his headquarters at Yokohama, he returned to take the treasurership of the Brush Co., and shortly after he was one of the active spirits of the Short Electric Railway Co. The absorption of these concerns by the General Electric Co. set him free for the work upon which he is now engaged, and in which he enjoys the co-operation of loyal and able associates.

THE WALKER MANUFACTURING CO.

No industry in Cleveland illustrates more forcibly the victory of electricity in urban transportation than the Walker Mfg. Co., whose splendid works and equipment once engaged almost wholly in the construction of cable machinery are now being largely devoted, under electrical management, to the production of the latest types of electrical generators and motors. These works and apparatus have already been illustrated or described in our pages;[1] but we are now able to present one or two additional views which emphasize the new departure. At the outset, the Walker Mfg. Co. under its new auspices, took up the manufacture of street railway apparatus a great deal of which was marketed during 1894, and of which a fine exhibit was made at the Atlanta street railway convention in October. We are, however, so much concerned with that at the present juncture as we are with the new machinery for lighting that the company is bringing out, all of which is the design of Prof. Sydney H. Short. We show herewith the dynamo for incandescent lighting just introduced to notice, and understand that it will shortly be followed up by a new arc machine.

It will be seen that the incandescent machine is very simple in construction. The frame, together with the

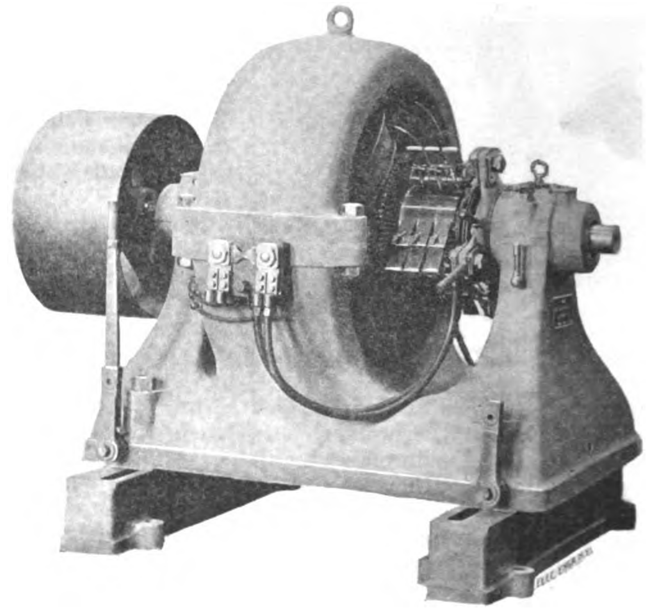
1. THE ELECTRICAL ENGINEER, Dec. 27, 1893; April 4, 1894.

Prof. S. H. Short.

lower half of the magnetic ring, is one piece, thereby insuring rigidity and stability in operation. The upper half of the magnetic ring is a separate casting and is bolted to the lower half. Laminated wrought iron cores for the magnets are cast into the magnetic ring; and after the magnet spools are slipped over these cores pole shoe tips are attached, to serve the double purpose of holding the magnet spools in place and providing "magnetic fringe" for commutation. The bearings are ball-and-socket, with automatic oil rings. The armature is of the toothed drum type, series wound, with a sandwiched winding, making a four path armature with twice as many commutator bars as there are slots in the armature. This arranges for the commutation of only half of the current for each bar, and ensures a very low pressure between the commutator bars. The 1,000-light machine of this type runs at only 650 revs. per minute. The armature, after five hours run at full load, only rises 60° Fah., above the surrounding air, and the field magnets but 50°. The armature is ventilated, a current of air being permitted to pass inside of the armature core, and out through radial ducts to the surface. Woven wire brushes are used on this machine, with the result of perfect quiet at the commutator, which takes on a glassy surface. Hard drawn copper is used in the commutator. The machines are compounded for from 5 to 10 per cent. loss, and are also arranged with equalizer terminals, so that they may be run in parallel. The Walker Co. are also manufacturing now a full line of direct-coupled 6-pole incandescent machines.

The management of the company is now in the hands of Frank Billing, President; J. B. Perkins, 1st Vice-President; S. H. Short, 2nd Vice-President; W. H. Bone, Manager; while Mr. H. McL. Harding has control of the selling of its railway apparatus, with headquarters in New York.

Prof. Short was born at Columbus, O., in 1857, and graduated from the Ohio State University in 1880. From his earliest school days he took an intense interest in electrical questions and experiments; so much so that he had constructed electrical devices for transmitting sound before the Bell telephone came out; and was able later on to sell the patent for a long distance transmitter to the Gold & Stock Telegraph Co. Equally early was his interest in arc lighting. He was closely associated with Prof. T. C. Mendenhall at Columbus, and gained no little benefit from the intimacy, until he was called to the Denver, Col., University, of which he became vice-president with the professorship of physics and chemistry attached. While in Denver, and amid much chemical and analytical work, he became deeply interested in electric traction; and some of his early achievements in that field there may be found in the books, especially the conduit system attempted with series motors in 1885. Returning to Ohio in 1887, he again tried the series method with overhead conductors, and various roads tested the plan, not altogether with failure, but with results that indicated the preferability of the multiple system for various practical reasons. Out of this important work grew the Short Electric Railway Co., in which the Brush Electric Co. secured a large interest. The absorption of both by the General Electric Co. brought to an untimely close some of the most interesting railway work ever done in this country. The contract for 200 Short motors for Rochester sent a stimulating thrill everywhere and marked the beginning of the enormous operations of to-day, while the trials with the Short gearless motor had an intense fascination for all classes of engineers. Just what the future has in store for gearless motors it is hard to say, but there are many observers who believe they are to be one of the final instrumentalities in the conquest of steam railroads.

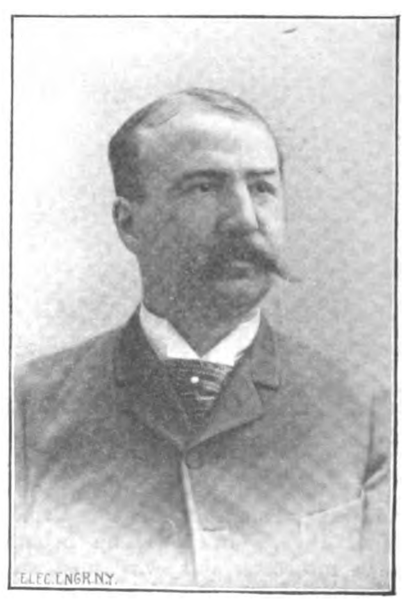


WALKER CO.'S INCANDESCENT LIGHTING 4-POLE DYNAMO.

By the passing of the Company bearing his name into new hands, Prof. Short was soon set free from his engagements with the Brush Co., and it was not long before the revolution in the affairs in the Walker Co. gave him a happy opportunity, of which he availed himself, as indicated.

It may be mentioned that Mr. W. H. Bone has been connected with the Walker Co. for fourteen years, and for upwards of five years he has been its manager, a position for which his professional skill as a mechanical draftsman and a specialist in gear and power transmitting machinery gave him excellent qualifications.

THE UNIVERSAL ELECTRIC CO.



N. S. Possons.

ONE of the newer concerns to engage in the manufacture of incandescent lamps is the Universal Electric Co., who have a large factory on Cedar Avenue, but who do not propose to push their business very actively until the situation in regard to patents shall have been thoroughly cleared up, leaving the future free from confusion and annoyance. While much cannot be said therefore about the factory, a good deal of interest will attach to the concern from the active connection with it of Mr. N. S.

Possons, a pioneer whose portrait is shown herewith.

The subject of this sketch was induced to go to Cleveland in 1879 by the urgent solicitation of Gen. M. D. Leggett, who was at the time President of the old Telegraph Supply Co. which was afterwards merged into the Brush Electric Co. Mr. Possons at once saw the merits of the Brush arc machine, and strengthened it mechanically by increasing the length of the bearings, increasing the diameter of shaft, and, best of all, making each and every part interchangeable, inventing jigs and fixtures for expediting manufacture. Being a strict disciplinarian he soon made a model shop, turning out first-class work, establishing a rigid inspection and most thorough test of all machinery before shipment, so that no claim could ever be made for faulty construction.

The price of construction was reduced more than one-half, just one year from the date of Mr. Possons' engagement with the company. Their factory building and machinery was then entirely destroyed by a fire. A new location was secured in the building known as Younglove's Works near the Euclid Ave. station, but this provided only a building. Engines had to be erected, and machinery bought to commence operations, all patterns and drawings had been destroyed, and Mr. Possons was his own draftsman. While following his men in erecting the new plant, he worked far into the night over his drafting table, made new drawings, and built patterns, so that in a very short time the first new machine constructed from new and complete patterns, was shipped and from that time the great business steadily progressed.

It was then decided by the directors to build their own works, and a novel plan and one which surprised the architect of the building was inaugurated. All machinery was carefully laid out to measurement on the floor plan, as well as engines, boilers, etc., etc., and the architect was instructed to build the walls around. The work was so arranged that castings and material came in one door and by regular succession passed out the other to shipment.

The line shaft in the immense works was the admiration of every visitor. A self oiling box was invented—and the entire line ran true and perfect and not one cent was necessary for repairs. By skylights all parts of the building were well lighted. The superintendent's office was elevated in the centre of the shop, overlooking the stock room, and safety vaults were placed under it.

When the Brush Co. passed into the hands of the great "combine," Mr. Possons resigned his position to accept one with the Belding Motor Co. of Chicago. The fatality of fire followed the erection of a suitable building for the manufacture of motors, and Mr. Possons returned to Cleveland and established The Universal Electric Company for the purpose of manufacturing incandescent lamps and for casting and tempering copper.

This company's factory is located at 737–739–741 Cedar Ave., and its output is steadily increasing under the conditions aboved named. The machinery connected with manufacture is new and novel and mostly automatic. The output is 1,000 lamps daily in ten hours, and the company are obliged to run over time to keep up with their orders. The carbon used is made from cellulose. The company are ready at any moment to double their output. Mr. Possons' associates in this business are W. J. Possons (a brother) who has invented many automatic fixtures, and is an inventor of merit. For twelve years he had charge of the production of the Brush carbons. Mr. C. C. Harris is also an active partner in the Universal Electric Co. Mr. Herman F. Scheadel, well known as a maker of incandescent lamps, and one of the first experts brought to this country in that branch, is the superintendent of the company, and the output is in his charge. With favorable conditions in the legal aspects of lamp manufacture, and with a factory well equipped, well manned and well managed, the Universal Co. hope to enjoy their full share of the business in the near future.

CASE SCHOOL OF APPLIED SCIENCE.

The Case School of Applied Science was founded by a bequest executed by Mr. Leonard Case in 1877. It was incorporated in 1880 and instruction began in 1881. The endowment and property amounts to-day to two million dollars nearly all of which is located in the city of Cleveland or its immediate vicinity.

The grounds and school buildings are on the south side of Euclid Avenue opposite Wade Park and, as the illustration. Fig. 1. shows, comprise three large buildings, the

FIG. 1.—CASE SCHOOL OF APPLIED SCIENCE.

main building, the chemical laboratory and the mechanical laboratory and principal dynamo room.

The course of instruction is strictly professional and is divided into eight courses as follows :

I.—Civil Engineering. II.—Mechanical Engineering. III.—Electrical Engineering. IV.—Mining Engineering. V.—Physics. IV.—Chemistry. VII.—Architecture. VIII.—General Science.

The time necessary to obtain a degree in any one of these is four years. The Faculty list contains the names of eighteen men exclusive of those who are rated as assistants, and the number of students for the current year is two hundred and sixteen.

In all of the courses of instruction, the title of the institution "School of Applied Science" is very strictly in-

FIG. 2.—CASE MECHANICAL LABORATORY AND DYNAMO ROOM.

terpreted, the shops and laboratories constituting a major portion of the total material equipment. More than half of the whole number of hours required of a student to entitle him to graduate are passed in them ; indeed this condition virtually makes all the afternoons of the school year a minimum requirement in the line of practical work.

The course in Electrical Engineering is one of the latest additions to the general scheme of instruction, and it took concrete form in 1892 when the present incumbent, Prof.

John W. Langley was called to the chair. The equipment of this department has been liberally pushed and it now has, 1 10 H. P. steam engine, 1 50 H. P. Corliss engine, 1 108 cell storage battery; 1 500 cell storage battery; 2 Edison 3 K. W. dynamos; 1 Gramme dynamo; 1 experimental alternating current dynamo, 1 500 light A. C. dynamo; 1 Standard secohmmeter 1 kiloampere balance; besides about $5,000 worth of measuring and illustrative apparatus. This is quite independent of the equipment in general physics, which has about $15,000 of apparatus.

There is a fact well known to practical men, which is, that knowledge of details only comes through familiarity with the specific concrete details of a business.

Recognizing this principle, the course in electrical engineering, in addition to methods of measurements and tests, leans strongly to the constructive side of the profession, and in order to give students the opportunity to learn some of the details of manufacture, there are now being built in the shops of the School and from designs executed by students or instructors the following:—1 2000 ampere generator, 1 two-phase generator, 1 two-phase motor, besides several smaller pieces of apparatus.

The 2000 ampere generator is intended primarily for electro-metallurgical work, but it can also be used for welding and high temperatures generally.

By it it will be possible to produce aluminum, magnesium, chromium, etc., and all those new and interesting products now being obtained by the electro-metallurgist in more than merely laboratory quantities.

The view Fig. 2 is of the mechanical laboratory and principal dynamo room, where are situated the large engine and the 500 light alternator. In Fig. 3 is shown one corner of the small dynamo room in the main building, where tests, characteristic curves and similar measurements are made.

During the administration of President Cady Stayley the large chemical and mechanical laboratories have been built. The next urgent need is for a similar separate building for the requirements of the Electrical Engineering department, and in view of the rapid growth in this line it is believed that such a building is a possibility in the near future.

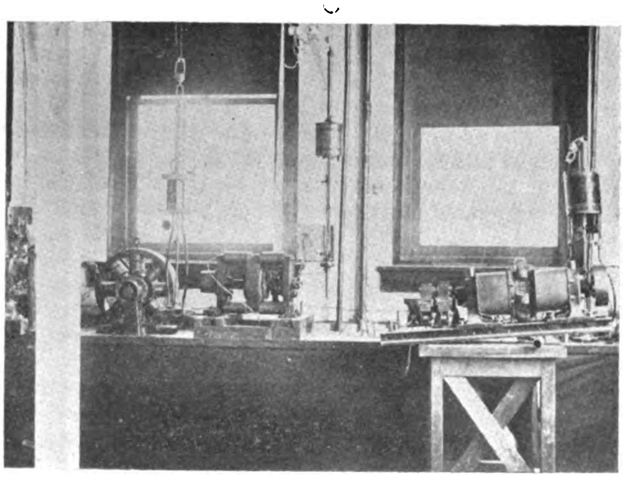
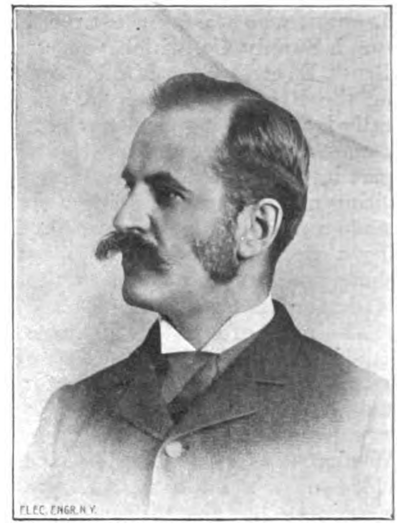


FIG. 3.—PART OF SMALL DYNAMO ROOM, CASE SCHOOL.

THE CLEVELAND ELECTRIC RAILWAY CO., have ordered from the Elwell-Parker Co. of America, Cleveland, O., a 1000 horsepower generator. It will be of the multipolar type, run at only 110 revolutions per minute, and be direct connected to a triple expansion condensing engine of the inverted marine type, built by the Globe Iron Works of Cleveland. The Elwell-Parker Co. have also recently contracted for three 100 horse power direct connected generators for lighting and power in Cleveland, and have a large number of other orders on hand.

PROF. E. P. ROBERTS AND THE CORRESPONDENCE SCHOOL OF TECHNOLOGY.



Prof. E. P. Roberts.

ONE of the distinctive institutions of electrical Cleveland is the Correspondence School of Technology established by Prof. E. P. Roberts, which is now going through its second winter of useful existence. Its headquarters are in the Brainard Block, on the Public Square, where oral instruction is carried on; while by means of the mail a large amount of educational work is done throughout the Union, the students receiving problems, etc., to work out, and returning the answers for advice and criticism. The attendance at the local classes has been good and the number of correspondence students is increasing. The membership is most varied as to age, education, experience and business position. Among the students are technical graduates and men whose education in schools has been extremely limited; young men in shops and superintendents of large concerns; railway chief engineers and roadmen; architects, patent lawyers, chief engineers of cities, draughtsmen in architects' and engineers' offices, stationary engineers and firemen, wiremen and lamp repairers, etc., etc.

Each department has at its head a man eminent in his profession, graduate of a technical school and engaged in the active practice of his specialty. Lectures sent and answers received are criticised by several other experts than the writer of the lecture. The work for the correspondence courses is usually prepared after a lecture on the subject has been delivered to a local class of varied membership. Such being the case, it is evident that special attention can be given to the points which have proved difficult to the local students, which are the same, in all probability, as those the correspondence student encounters. The plan as a whole works admirably, and one can only wish Prof. Roberts an abundant success in his enterprise.

Besides this educational work Prof. Roberts, under the firm name of E. P. Roberts & Co., carries on a business in mechanical and electrical engineering, his associate by Mr. W. B. Stewart, a veteran engineer of 28 years' experience in the management and erection of steam machinery, and 10 years' in electrical apparatus. Prof. Roberts has also found his hands full of late of consulting work, in which he has until lately enjoyed the co-operation of Mr. C. F. Uebelacker, now chief engineer of the New Jersey Consolidated Traction Co.

Prof. Roberts was born in New York City in 1857; graduated from Stevens Institute of Technology—M. E., twenty years later; worked in machine shops up to the grade of superintendent, and in 1880 was assistant to Mr. Hiram S. Maxim, of machine gun fame, who was then electrician of the U. S. Electric Lighting Co. When that company consolidated with the Weston Co., he was appointed an assistant in Mr. Edward Weston's laboratory. He was afterwards with Mr. Wm. Stanley, in the American Co., and the Swan Co. in Boston. From 1883 to 1888, he was manager and superintendent of the Cheyenne, Wyo., Electric Light Co., and also in the latter part, superintendent of the Gas Co. He was engaged in consultation work, and was vice-president of the Fort Albins Elec. Light Co.

The Cheyenne Co. was noted for its experience with storage batteries—at first using them as the sole source of current for incandescent lighting and afterwards erecting a station for constant potential distribution, placing the batteries in the station, and furnishing day current from same, charging with the arc dynamos late at night after some of the commercial arc circuits were discontinued. This was, probably, the first installation of the kind in the country.

In 1888–1889, Mr. Roberts became Associate Professor of Electrical Engineering, at Sibley College, Cornell University, but was called to Cleveland, as superintendent and afterwards manager, of the Swan-Lamp Mfg. Co. In 1892, with Mr. C. F. Uebelacker he started a consulting office in Cleveland, which he still continues, and which enjoys a good reputation, having not only made plans and specifications for new plants, but a number of reports on existing plants, and on proposed enterprises. His experience as manager, as well as engineer, give his reports exceptional value. In 1893, he started the Correspondence School of Technology, which now has eleven instructors. Mr. Roberts is a member of the American Institute of Electrical Engineers, The American Society of Mechanical Engineers, the Cleveland C. E. Club, the Cleveland Electric Club, the Cleveland Chamber of Commerce, and an honorary member of the Buffalo Electric Club. A number of his papers have appeared in the transactions of the above societies and in technical journals.

THE ELECTRIC CLUB OF CLEVELAND.

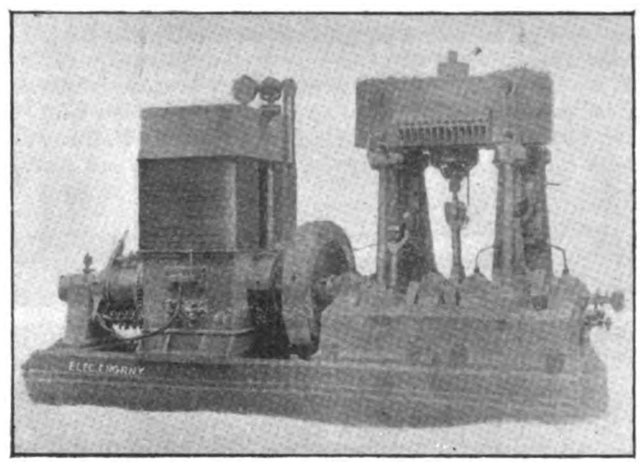
C. W. Wason.

UNDER the energetic and intelligent presidency of Mr. C. W. Wason the Cleveland Electric Club has made itself a power and benefit in the community which harbors it and an example to similar institutions wherever found. It was established in 1891 to provide its members with opportunities and means for the study and discussion of electrical subjects; to promote social intercourse among its members, and to furnish a library and reading room. In all respects it has been highly successful. The comfortable rooms of the Club are at 356 Superior street, where there is a thoroughly good library and where the reading room is well supplied with current technical literature. There is also a billiard room. The large front room serves to accommodate on the first and third Wednesdays of the month the regular meetings of the Club when various technical topics are carefully presented in papers or addresses and then vigorously discussed. With a membership of about 100, as many as 50 or 60 members will turn out at a time for these meetings, and the interest is steadily maintained. The annual meeting takes place on the first Wednesday in October. The resident dues are $12 a year, the initiation fee being $5. Non-resident members are not required to pay dues, but continue in good standing under the original and ingenious condition that they shall present one paper a year. The officers for 1894–5 are: president, C. W. Wason; first vice-president, B. M. Barr; second vice-president, T. E. Adams; secretary, H. J. Davies; treasurer, E. W. Moore; board of managers, C. W. Wason, H. J. Davies, E. W. Moore, R. M. Fuller, G. W. Cleveland. During the stay of the members of the N. E. L. A. in Cleveland, the hospitalities of the Club are freely extended to them.

THE ELWELL-PARKER ELECTRIC CO. OF AMERICA.

The above company is a newcomer in the field of electrical manufacturing in the United States. It was organized here a little over a year ago with Cleveland capital, by Cleveland men, all of them being manufacturers themselves. A purchase was made of all the American patents, rights, franchises, etc., from the Electric Construction Co. (Elwell-Parker) of London and Wolverhampton, so that the apparatus produced here will correspond in type to that which already bears the name so well-known abroad. The Elwell-Parker dynamos, motors, etc. have been in use since 1881 in all parts of Great Britain and all over the world; and readers of THE ELECTRICAL ENGINEER will recall our illustrated descriptions of it in connection with the large Manchester, Eng., central station[1] and the Liverpool Electric Elevated road[2]. These and other installations have made an enviable record for high efficiency and all round reliability. It is said that the larger part of the electrolytic work in England is done with Elwell-Parker generators, and that the transmission and distribution of direct current over long distance is another of the fields in which the apparatus of this make has been very successful.

In Cleveland, the Company enjoys the extensive facilities of a large annex to the celebrated works of the Brown Hoisting & Conveying Company, and it is already making a good deal of electrical machinery, one recent order having been for 1,000 H. P. Its specialty is the "heavy current" class of apparatus, but it is also equipped for miscellaneous production, and we illustrate here one of its 80 K. W standard units for ship lighting, direct connected and running at 240 revs. per minute. It is also engaging in the manufacture of railway generators and of gearless railway motors.



ELWELL-PARKER DIRECT-CONNECTED SHIP LIGHTING UNIT.

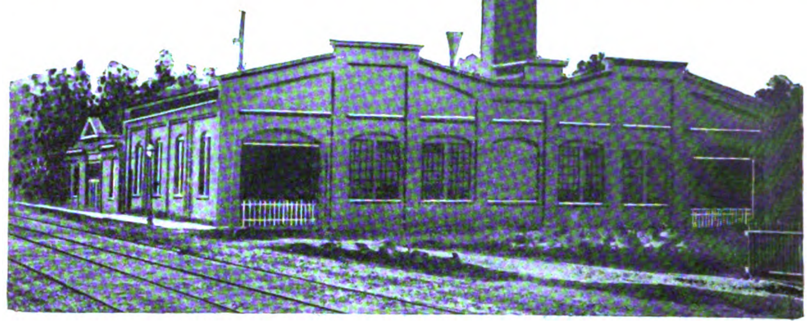
The officers of the company are: F. C. Phillips, president; E. B. Phillips, vice president; Alex. E. Brown, secretary and treasurer; and E. S. W. Moore, superintendent. Mr. F. C. Phillips,—a relative of Mr. C. F. Brush,—has had a large and varied experience abroad in every branch of electrical engineering. Mr. E. B. Phillips has had 14 years with electrical industries in this country. Mr. A. E. Brown is the inventor and manufacturer of the world-famed hoisting and conveying machinery that bears his name, and which may be said to have revolutionized the handling, in large quantities, of ore, coal, pig iron and other raw material.

1. THE ELECTRICAL ENGINEER, Nov. 7, 1894.
2. THE ELECTRICAL ENGINEER Feb. 15, 1893.

ELECTRIC RAILWAY WORK IN CLEVELAND.

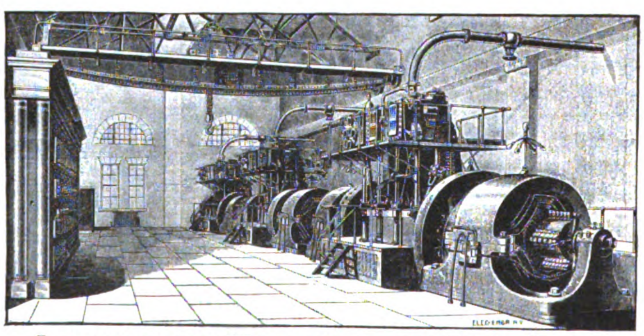
As everyone interested in electric lighting is also interested in power house design and construction, it will be fitting in the present issue of The Electrical Engineer to give a little information on what has been done in Cleveland in that branch of the art. The street railway system of the city to-day is almost wholly electrical, and is practically in the hands of two well managed companies known locally as the "Big" and "Little" Consolidated; or to visitors as the Cleveland Electric Railway Co. and the Cleveland City Railway Co. The former had, by last reports, about 120 miles of track, used by 240 motor cars and 242 trail cars. Its "East Cleveland" power house of which an exterior view is here given, is a most interesting exemplification of evolution in current generation and the trial of various types of steam and electrical apparatus, beginning with an admirable equipment of Armington & Sims engines, driving bipolars, and working through Cooper-Corliss engines driving multipolars. In the Cleveland Electric Railway Co. are consolidated the East Cleveland, Broadway & Newburgh, Brooklyn and South Side companies. The officers are H. E. Andrews, president; H. A. Everett, vice-president; R. A. Harman, secretary; L. E. Beilstein, assistant secretary; J. Parmalee, treasurer; J. J. Stanley, superintendent; and C. W. Wason, purchasing agent and electrical engineer. It will be noted that some of the officers here named are among the enterprising spirits who have electrified and consolidated the street railway system in other cities, both in the United States and in the Dominion of Canada.

The Cleveland City Railway Co.'s system is partially cable, but it comprises also 52 miles of electric road. The company includes the Cleveland City Cable Railway; the South Side Street Railway Co. and the Woodland Ave. and West Side Ry. Co. It has altogether about 150 motor cars and 175 trail cars, the system being Westinghouse. The officers are M. A. Hanna, president; F. De H. Robinson, vice-president; G. Mulhern, superintendent, and J. B. Hanna, secretary and treasurer.

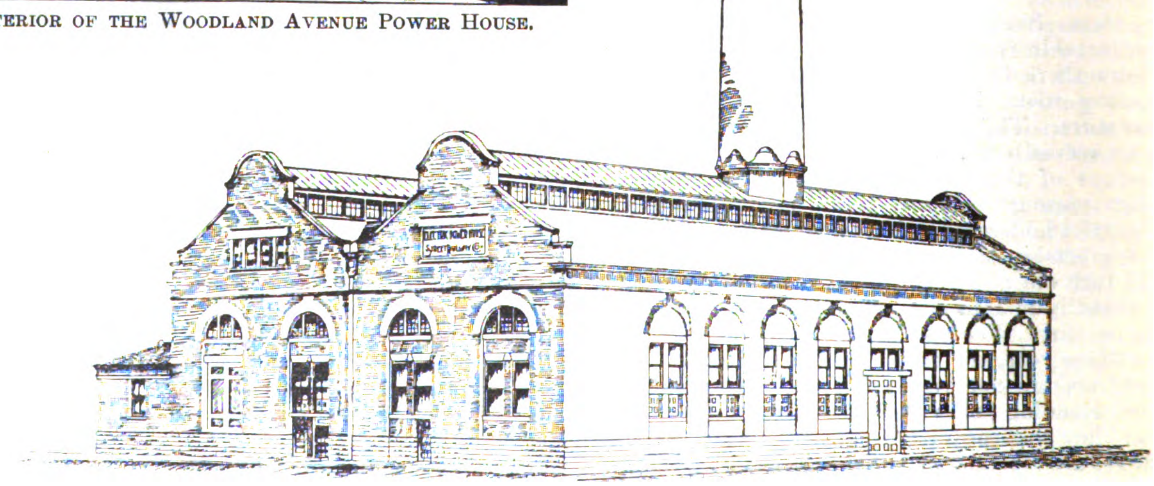


Scovill Avenue Power House.

Perhaps the most interesting and modern of all the plants is that of the Cleveland City Railway Co. in its Woodland Ave. and West Side power house. Our illustration shows three marine engines there, each driving two Westinghouse generators of 250 h. p. each. The engines are of the regular marine type made by the Globe Iron Works of Cleveland, and are of 500 h. p. each. There is another unit of 500 h. p. engine which is not seen in the engraving, but which drives a single 500 h. p. Westinghouse generator. The shafts are not continuous through the engines and dynamos. Those of the dynamos and of the engines are in line and are connected by a universal coupling. The springs of this coupling allow the generator



Interior of the Woodland Avenue Power House.

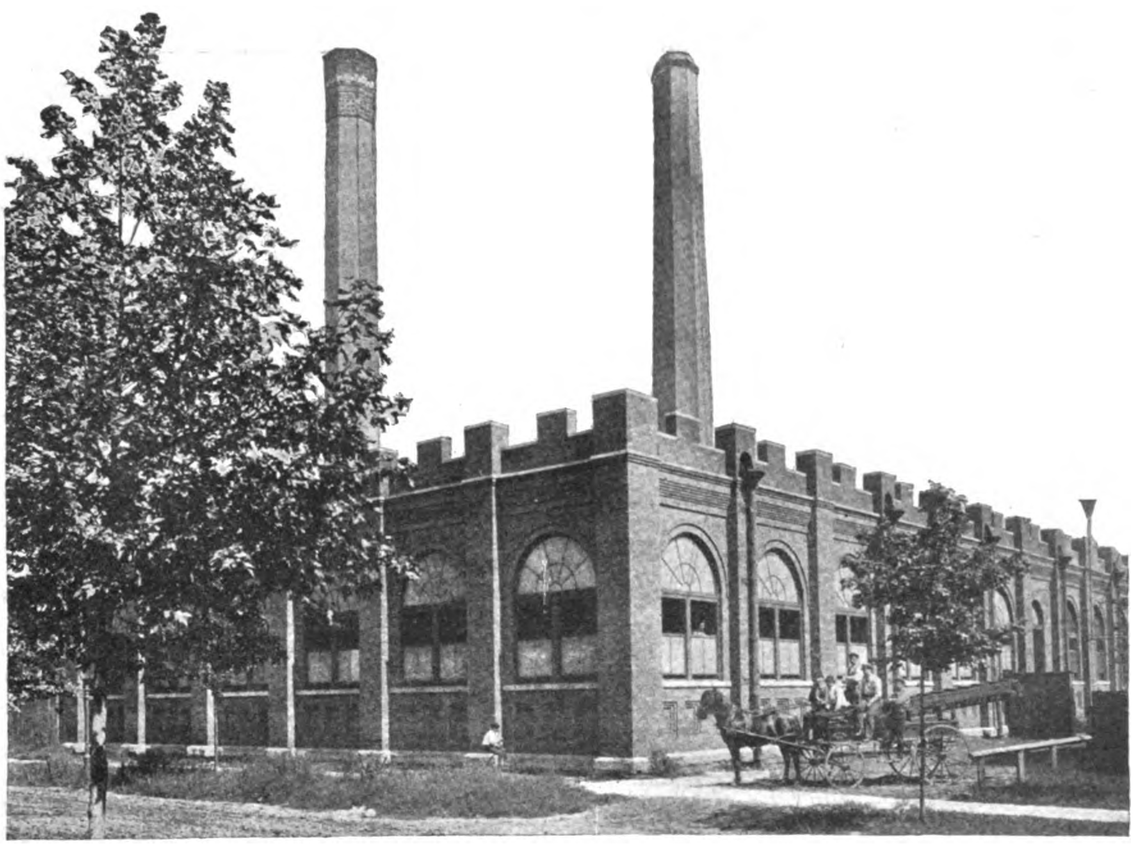


Woodland Avenue Power House of the Cleveland City Railway Co.

shaft to sag backward slightly in case of a suddenly applied excessive load on the generator, but hold it firmly to place, under ordinary conditions. The couplings mentioned were by nine-inch bearings, the outboard bearings being 14 inches. Each engine with two generators carries fly-wheels on each side, 8 feet in diameter, with a rim 16 inches on

POWER HOUSE OF THE BROADWAY AND NEWBURGH SYSTEM.

designed by the Westinghouse Company. The engines are triple expansion, with cylinders 14, 23 and 36 inches, by 24 inch stroke, the receivers having nearly the capacity of the following cylinder. They run at 146 revolutions per minute. Each piston has its own connecting rod to the crank the face, and 9 inches deep, while the engine, driving a single unit has a double sized fly-wheel between the engine and the generator on the engine shaft. The speed is regulated by operating the regular Joy valve gear by a Porter-Allen governor, with a hydraulic cylinder. Steam is ad-



EAST CLEVELAND POWER HOUSE OF THE CLEVELAND ELECTRIC RAILWAY CO.

shaft, the three cranks being set at 120 degrees. The shaft is $7\frac{1}{4}$ inches in diameter, and 33 feet 7 inches long over dynamo and all. It is supported between each crank mitted to the high-pressure cylinder at 150 to 160 pounds pressure, and expanded to 45 pounds for the intermediate, and to 5 pounds for low pressure, where a vacuum of from

22 to 23 inches is maintained by independent Blake condensers, discharging into a general pipe from which the boilers are fed through a horizontal Goubert heater, taking the exhaust from the several pumps. The temperature of the feed water is thus maintained at 210 to 212 degrees, and as mineral oils are used for lubrication, no annoyance is experienced from oil in the boilers. The boilers of the plant are also of the marine type. Each boiler discharges its steam through a 5 in. curved pipe into a main carried along the top of the engine room side of the boiler house, and thence by feed pipes brought through horizontally and with a downward curve to the engines, as seen in the cut.

RECEIVING THE ASSOCIATION IN CLEVELAND.

One of the first steps of Mr. C. W. Wason on accepting the chairmanship of the Local Reception Committee was to organize a strong and representative body for the work. The gentlemen constituting his committee are as follows: Myron T. Herrick; W. H. Lawrence; H. E. Andrews; E. P. Roberts; F. De H. Robinson; C. F. Brush; R. Lindsay; W. B. Cleveland; E. A. Sperry; C. Corlett; J. P. McKinstry; M. A. Hanna; S. M. Hamill; C. H. Rockwell; J. Potter; F. Billings; N. S. Possons; E. L. Babcock; S. Scovil; A. V. Kurtz; G. M. Hoag; C. S. D. Johns. These names are associated with all branches of electrical manufacturing and utilization in Cleveland. In addition to these, a committee has also been organized for the reception and entertainment of the ladies.

The badge colors adopted by the Association for its Cleveland Convention are as follows: officers, blue bow; executive committee, red; active members, blue; associate members, olive; guests, pink; honorary members, white; reception committee, yellow.

In addition to the programme printed in the ENGINEER last week, the secretary is now able to make the announcement that at the opening session Mr. C. F. Brush will be introduced and will deliver an extemporaneous address on "Some Early Reminiscences of Arc Lighting." In view of the extreme rarity of Mr. Brush's public appearances, and the fact that this will be the first time he has graced an electric light convention, it is needless to say that no greater favor or pleasure could be afforded the members of the Association on their visit to Cleveland than this.

THE STEEL MOTOR CO.

Although its products are not of the kind used in electric lighting, the Steel Motor Co. of Cleveland, has a prominent place among the electrical industries of the city, and has built up a good market in connection with electric railway enterprises. It builds what is known as the "steel clad" motor, now in use on some of the cars in Cleveland, and adopted lately, among other places, for Yonkers, the New York suburb. Its other principal specialties are the Harris trolleys and Harris trucks. It has a large armature department, which furnishes armatures for railway motors, stationary motors and generators, of all the familiar systems. Another branch of its work is that of furnishing motor field coils and generator fields. All this work is done with much care. The factory is on Stanton street. The active officers of the company are Messrs. S. Harris and R. T. Lane.

THE FOREST CITY ELECTRIC WORKS.

One of the specialized electrical industries of Cleveland is that known by the above name and carried on by Mr. W. B. Cleveland. It is devoting its energies with much success to the production of "roll drop" commutator bars for dynamos and motors. These are cast from pure lake copper, rolled and pressed to size by special machinery, which turns out a dense, accurately formed bar of remarkable durability, which may be said to be toughened rather than hardened. Their peculiar quality allows the glaze over the commutator as a whole to reduce greatly the mechanical friction of the brush, and thus adds considerably to the life of an expensive portion of the machine.

CLEVELAND ELECTRICAL MISCELLANIES.

Besides the various concerns that have been described or alluded to in various other articles appearing in this issue of THE ELECTRICAL ENGINEER, mention must be made of several others, of less pretensions perhaps, but often of great activity and merit in their respective fields. Of course, there are agencies of outside companies, in Cleveland, and one of the most prominent is that of the C. & C. Electric Co., whose representative, Mr. Houghton, has excellent headquarters in the Cuyahoga Building. The C. & C. motors and generators enjoy an excellent repute in Cleveland and vicinity. The electrical supply business in Cleveland is handled chiefly by the Electrical Supply & Manufacturing Co. and the Union Electric Co. Storage battery interests in the city are represented by the Ohio Storage Battery Co., Mr. George Hoyt, Wade Building, of whose work reference has been made from time to time in these columns. In the same building are the offices of Ford & Smith, electrical engineers and contractors. The members of the firm are E. S. Ford and G. J. Smith. Their business consists not only in the design and installation of plants, but the sale of generators and motors, a specialty being made of slow speed types. The Elliott-Lincoln Co. has built a few motors, and of late has also installed one or two lighting plants. So far it has not invited outside business, devoting its energies to work in the immediate vicinity of Cleveland. A new concern is the Non Magnetic Arc Lamp Co., and another is that which has recently started with the intention of introducing the "Paragon" insulating material. It has its offices in the building of the Society for Savings.

THE SPERRY ELECTRIC RAILWAY CO.

Part of the work of the large Brush factory in Cleveland consists in the production of Sperry motors for railway work and of Sperry magnetic brakes for cars. These devices have already been illustrated and described from time to time in the pages of THE ELECTRICAL ENGINEER, and it is not necessary to touch upon them again now. But a few words will not be out of order, in regard to the electrical engineer and inventor whose name the company bears, Mr. Elmer A. Sperry, especially as that gentleman won his laurels first in the distinctive field of electric lighting.

Mr. Sperry was born in Cortland, N. Y., October 12th, 1860; educated at the State Normal school, Cortland, and at Cornell University. From 1880 to 1884 Mr. Sperry's principal work was in arc lighting, and consisted in the development of the independent feed lamp, the automatic current regulators, and later the perfection of the reactionary effect between the armature and field allowing the rotation of the brushes, controlling thereby the electromotive-force at first through a small range, which now has been increased to total range from 0 volts to 6,000 volts on the 125 arc light machine, without the least evidence of sparking, and actually burnishing the commutator, as in the best constant potential work.

Mr. Sperry owned and operated the first large central station for arc lighting in the city of Chicago, operating all wires underground. At this time he was active in organizing the electric lighting interests for mutual interchange of ideas, etc., and was chairman of the committee of call for the first convention of the National Electric Light Association held in Chicago in 1885. About the same time he went to New York to aid in the organization of the American Institute of Electrical Engineers, of which he became a charter member, being the fifth member on

Elmer A. Sperry.

the original list. He is also a member of the Illinois Mining Institute.

Mr. Sperry has designed and put into operation a number of machines and plants for mining coal and handling it underground by means of electricity. This part of his work is described in papers read by him before the American Institute of Electrical Engineers and the Illinois Mining Institute. His direct blow pick machine; shearing machine; longwall machine; room and pillar machine; breast machine and electric blasting drill, are in operation in a number of states. Besides these he has designed and constructed three types of electric mine locomotives, which have eight driving wheels driven from a single motor, and are adapted to take short radius curves and work on light track with heavy "draw-bar pull." These locomotives are operated entirely in underground service in mines, and some are working on very long hauls. He has also perfected a number of special devices found necessary for handling heavy electric currents in mines, and has put in plants for operating large rope haulage systems by electricity, a number of electric pumps, etc., etc. The dynamos used for operating these plants are of a special type designed by Mr. Sperry expressly for mine service.

For a number of years Mr. Sperry's attention has been directed to perfecting a system of electric street car equipment, which is a radical departure from that heretofore employed. In the "Sperry" system of propulsion, a single motor is used, which is elastically supported from the truck frame, and flexibly connected to both axles of the car, the axis of the armature being lengthwise of the car. Realizing the inefficiency of the hand brakes for stopping cars propelled by electricity, he next set about to design and perfect a brake operated by electricity which should be powerful enough to place the car under perfect control of the motorman, enabling him to stop it at will, thus preventing many serious accidents. This brake in connection with the Sperry motor is now in use on street railways in many of the principal cities in this country.

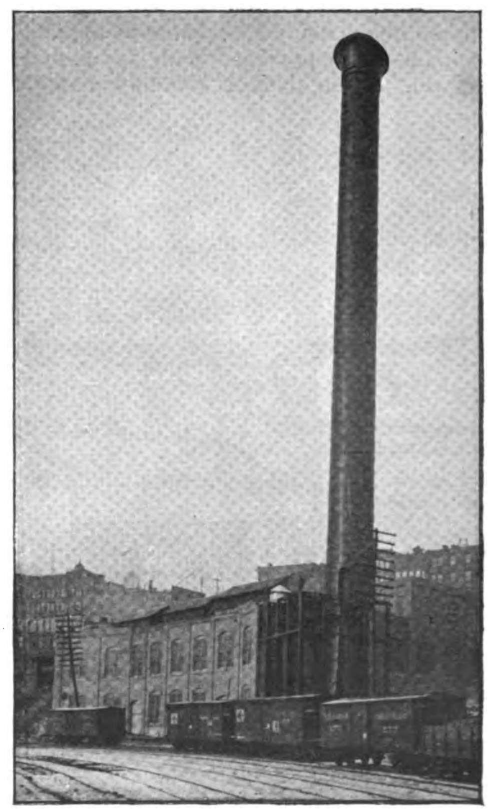
Mr. Sperry besides being the author of a number of valuable papers bearing on electrical subjects, especially such as relate to the problems of electric propulsion for street cars, gearing of motors, electrical braking, etc., has also taken out a large number of patents on his inventions in various fields of electrical and mechanical engineering, and was never more actively inventive and progressive than at the present time.

ON VARIATIONS OBSERVED IN THE SPECTRA OF CARBON ELECTRODES, AND ON THE INFLUENCE OF ONE SUBSTANCE ON THE SPECTRUM OF ANOTHER.

In this paper (*Proc. Royal Soc.* Vol. 55, No. 334) Professor Hartley reiterates his belief that the so-called "cyanogen" bands are in reality due to the element carbon, not to a compound of carbon and nitrogen. He thinks that the differences between the "cyanogen" bands and the "carbon" bands are not too great to be accounted for perfectly by the variations in the external conditions under which the discharge passes between the carbon poles.

THE NEW PLANT OF THE CLEVELAND ELECTRIC ILLUMINATING CO.

We illustrate and describe herewith the new central station of the Cleveland Electric Illuminating Co., near the Cuyahoga River, built during 1894, and barely yet in full swing. The building which rests on piling is located on Canal Street, and extends back to the Valley Railroad. The Cuyahoga River is about 200 ft. from the rear of building; the Railroad being between the river and building. The building which itself does not cover the entire lot, enough ground being left for future extensions of the plant, is 125 ft. long and 70 ft. wide. The boiler room and engine room are 36 ft. clear between floor line and roof trusses, and the front part of the building is three stories in height. The first floor in front of the building is occupied as a shaft room and is on a level with the engine room floor, which level is two feet above the boiler room floor line. The second floor is the dynamo room, and is 18 ft. above the engine room floor. This room is about on the level with the sidewalk line in front of the building. The third floor, or store room, is 18 ft. above the dynamo floor, and has a clear head room under roof trusses of 12 ft. The engine room and boiler room are separated from each other by means of a fire-proof wall extending up to the roof line. The shaft room and engine room are practically one room, and as the dynamo and store room roofs and floors are supported by means of a large row of steel columns, the dynamo room and engine room and shaft room are practically one room; thus allowing the entire operating force in these rooms to be in close and easy communication. The building is composite in construction; the frame being made of steel throughout. The steel columns in the engine and dynamo rooms are used as supports for crane girders for the two travelling Yale & Towne



NEW STATION OF THE CLEVELAND ELECTRIC ILLUMINATING CO.

cranes. That in the engine room has about 28 ft. span with two geared trolleys and hoist, and has a total capacity of 10 tons. The dynamo crane has a capacity of 6 tons, and has a single geared trolley and hoist. Both

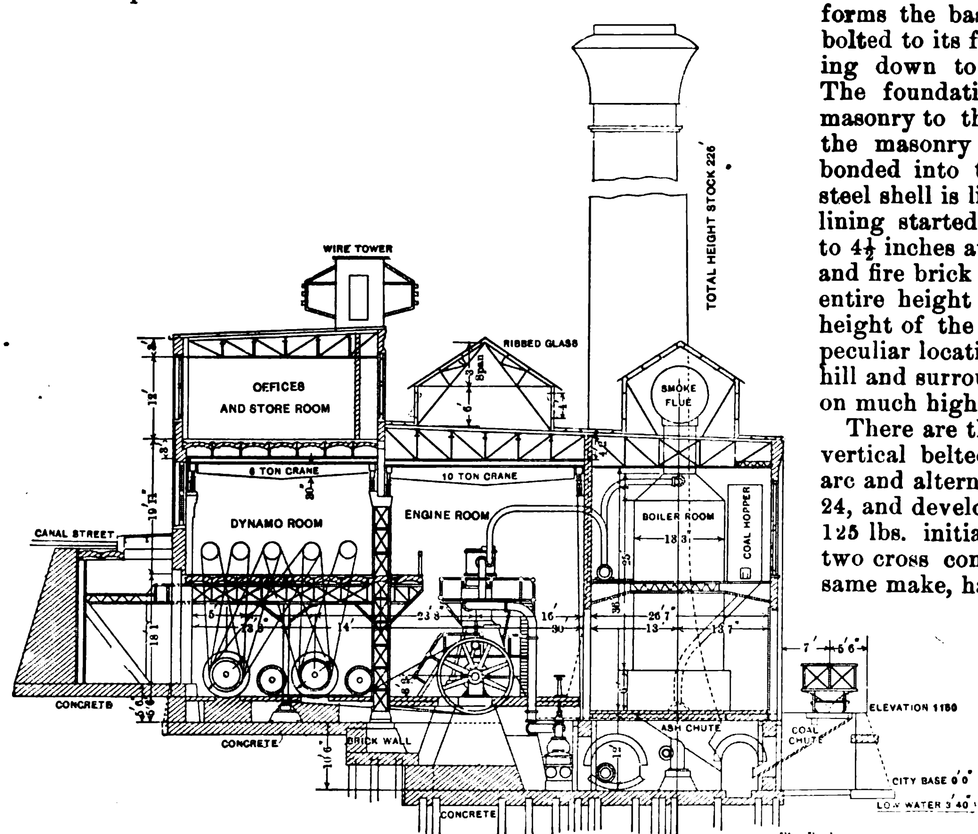
cranes have fish belly double plate girders, and are operated by hand. These cranes travel the entire length of the dynamo room and are capable of handling any part of the engines or dynamos. The building has a basement under both engine and boiler rooms. A layer of concrete two ft. thick on all the piling forms the foundations for the lime walls of building and machinery foundations. The trimmings of the building are of Berea sandstone and all capstones for piers and engines are of blue stone.

The floors throughout the building consist of steel beams with brick arches and concrete filling with the exception of the shaft room floor which is of solid brickwork and concrete. The store room and dynamo room floors are finished with a double wood floor. The boiler room floor is finished with a layer of vitrified brick laid flat. The engine room floor is finished with Portland cement on top of the brick arches. Both the engine and boiler rooms are furnished with ventilators. The engine room is furnished with a large skylight having a movable glass sash the entire length for light and ventilation. The top of the skylight is glazed with ¼ in. ribbed glass. The boiler room is ventilated by means of steel ventilators having fixed steel slats and doors to gain access to the smoke flue. This smoke flue is placed in louvres to economize space and extends directly over the boilers to the steel stack at the end of the building. The wall between engine and boiler rooms contains one small and two large sliding doors of fire-proof design. The entire roof of the building consists of gravel laid on roofing felt which in turn is asphalted to three inch roofing tile laid on steel tie bars. The entire roof of the building is flashed with copper and all conductors and leader pipes are made of the same material.

The boilers are four in number and of the Climax Morrin vertical type; three of them being rated at 800 H. P. each, and one at 500 H. P. on 30 lbs. evaporation of water per hour. They are built for 200 lbs. working pressure, but the pressure to be carried on the plant at present will only be 125 lbs. They are provided with individual dampers. Space has been left in the boiler room for two additional 800 H. P. boilers. The coal is dropped from the bottom of hopper cars on the siding into a pocket and delivered inside of the wall of the boiler room basement. By means of valves inside the building the coal is delivered to coal handling apparatus, and transferred to the coal storage at the extreme end of the building, or directly into individual coal hoppers between the boilers in the boiler room, as desired. These individual coal hoppers have a capacity of 8 tons each, and are provided with scales and other apparatus for weighing coal delivered to firemen. The coal storage is of peculiar design. The walls consist of vertical steel posts with vertical segmental arches of brickwork turned between flanges and having the convex side of the arch turned inward with tie rods between the posts to take the thrust of the coal. This coal storage is placed around the base of the steel stack, and is the same height as the building proper, *i. e.* about 43 feet. The floor of the coal storage consists of steel beams and steel plates with chutes to deliver the coal to the handling apparatus underneath, so that the space can be emptied as may be desired. The capacity of coal storage is 550 tons. Additional storage capacity is also to be had under the railroad siding along the boiler house. It will be seen that the total capacity of this coal storage can be handled without retrimming any of its contents. The ashes are removed by the same means as are used for handling the coal; and hoppers are provided under each boiler with valve, etc., necessary for holding a day's run of ashes. An ash storage is formed at the extreme southern end of the building for receiving ashes until such times as they can be removed by carts drawn under the storage and the same emptied by means of valves opening either into carts or railroad car.

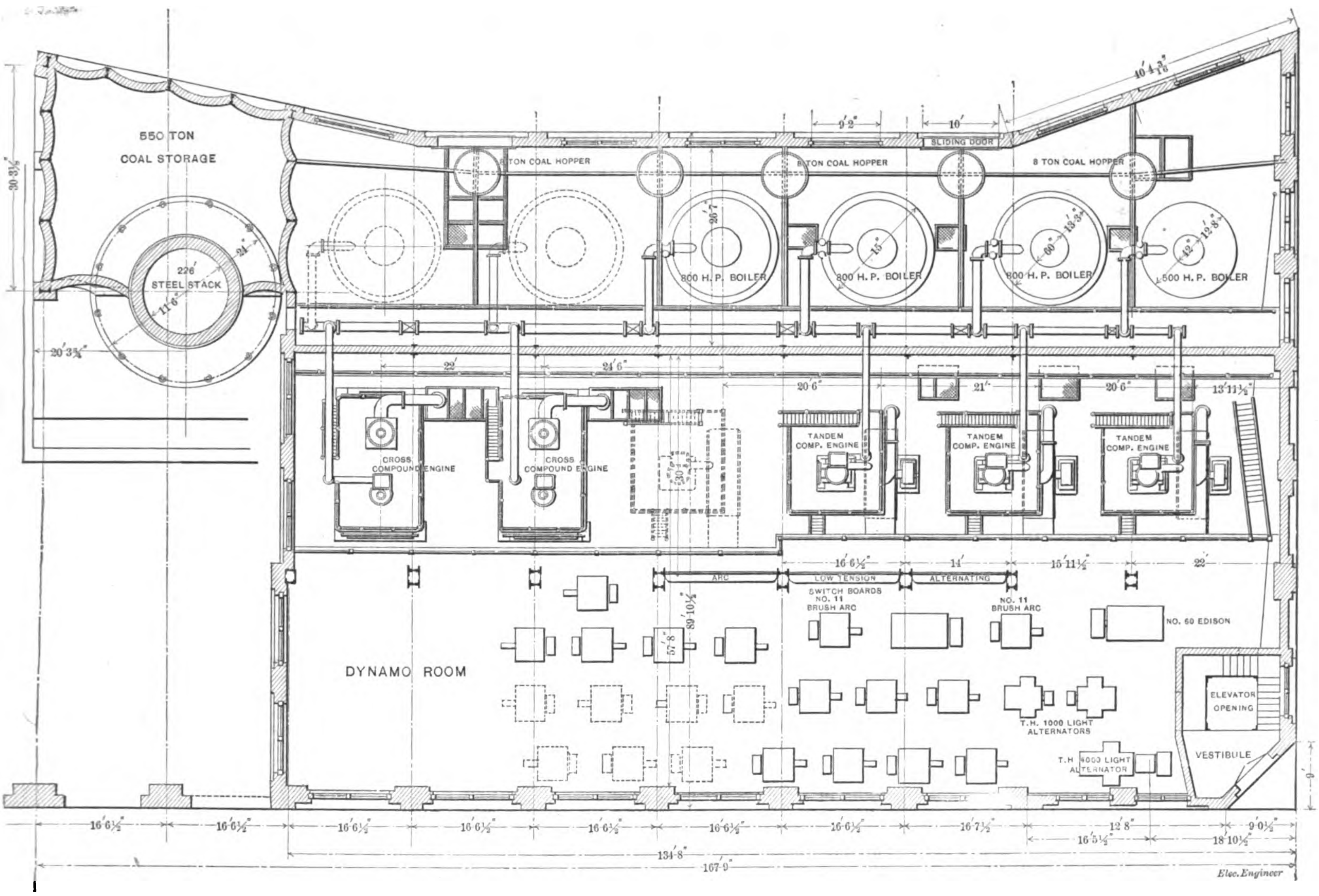
The splendid stack, made by Riter & Conley, Pittsburgh, is 226 ft. in height above stack base, 25 ft. 6 in. at cast iron base, and 11 ft. 6 in. clear diameter inside of the brick lining at the top. It has sufficient capacity to take care of any increase of plant. It is built of steel plate $\frac{7}{16}$ inch thick at the bell base, and diminishes in thickness up to the top plates, which are ¼ inch thick. The steel portion of the stack base is riveted to a heavy cast iron ring which forms the base of the stack proper, and which in turn is bolted to its foundation by means of heavy bolts extending down to the masonry and secured to the piling. The foundation of the stack proper consists of brick masonry to the depth of 12 ft. laid in hydraulic cement, the masonry measuring about 35 ft. square and being bonded into the engine and building foundations. The steel shell is lined its entire length with a tapering brick lining started 21 inches thick at the bottom, and tapering to 4½ inches at the top. This lining is composed of red and fire brick and the inside surface of the lining faced its entire height with good West Virginia fire brick. The height of the stack was made necessary on account of the peculiar location of the building; it being at the foot of a hill and surrounded to a great extent by buildings located on much higher ground.

There are three McIntosh & Seymour tandem compound vertical belted engines which drive the shafting for the arc and alternating generators, with cylinders 19 by 36 by 24, and developing 750 H. P. each at 150 revolutions with 125 lbs. initial pressure and condensing. There are also two cross compound vertical condensing engines of the same make, having two 200 K. W. General Electric multipolar generators connected direct. These cross-compound engines have cylinders 20 by 36 by 24, and develop 800 H. P. at 150 revolutions on 125 lbs. of steam when condensing. The engines are of the makers' latest type, having piston valves on high pressure cylinders with riding cut-off, and governed by means of a shaft governor. The low pressure cylinders have gridiron valves, and all bearings and slides are water jacketed, and the engine is of heavy



Cross Section of the New Cleveland Lighting Station.

well balanced design. Each engine has its condenser; there being five Worthington duplex 12 by 15 by 15 condensers, and so arranged that any engine can be thrown on any condenser. Each condenser is located as near as possible to its corresponding engine in the engine room basement, and can be operated from the engine room floor by the regular force in the engine room. Open cast iron plates are arranged directly over the condenser so that the working parts can be seen. This permits the entire condensing part of the plant to be operated by the engineer on watch and tongue and grooved flanges. The wrought iron mains are threaded on the ends and have cast iron screw flanges adjusted on the inside of flanges before erecting. The exhaust piping is entirely of cast iron as is also the discharge and a portion of the injection pipe. The exhaust and discharge mains are 24 inches in diameter. The injection main is 18 inches in diameter, and so arranged that an additional main can be put up for the future plant. In the branches for the engine exhaust to the exhaust main, 14 inch relief valves are used, and the



Plan of the New Station of the Cleveland Electric Illuminating Co.

instead of having extra men in the basement doing nothing else but operate condensers.

The steam pipe between the engine and the boilers is arranged to be as direct and simple, and have as little drop in pressure as possible; and at the same time take care of all expansive strain. The 14 inch wrought iron main is reduced at the ends and extends the entire length of the boiler room resting on specially designed girders and expansion rollers as firmly as if on foundations. This main has branches extending through the partition wall of the boiler room to the engines, and has also branches to the boilers with valves on the same. The main is cut up in different lengths by means of valves so that practically any boiler can be thrown on any engine, and the main separated in lengths, so that renewals of gaskets can be made in the main without shutting down more than one engine at a time. The valves on the entire plant are Chapman gate valves. On the steam line they are extra heavy ribbed shells, outside screw and yoke, bronze seats, plant is arranged so that it can be made condensing or non-condensing at any time in case of necessity or emergency. The steam fitting was done by Best, Fox & Co., of Pittsburgh.

A 3,000 H. P. Hoppes heater is used for heating the feed water for the boilers. Pumps are placed in the basement, and take the water from the heater and deliver it to the boilers through feed lines, or blow off lines, if necessary. The water in the heater is heated by means of exhaust steam from independent condensers and feed pumps.

The injection water is taken from the cold well located inside the building with a lift of about 10 ft. This well is connected with the Cuyahoga River by means of a 24 inch inlet pipe. The outboard end of this pipe is connected with a 10 by 10 by 10 ft. crib sunk in the river and secured by means of piles driven in the river bed. The 30 inch discharge pipe extends from the building to the river, as well as the 8 inch cast iron blow-off pipe. These pipes are laid under the Valley Railroad tracks.

The shafting and pulleys for driving the 14-125 light Brush dynamos, and the three alternating current machines, were built and erected by the Hill Clutch Co.

Besides the two pair of 200 K.W. General Electric direct connected generators for low tension work, there is installed in the dynamo room 14-125 light Brush arc machines of latest pattern with automatic regulators, 3 T.-H. alternating current machines, one of 4,000 and two of 1,000 lights capacity each. There are also two No. 60 Edison bi-polar machines for low tension work which are driven from shafting. Everything is as compact as possible.

It will be seen that the Company has had to encounter peculiar conditions in the design and construction of its plant, and that to meet a varied demand, apparatus of different types is assembled in the one station.

The officers of the Company are: James Parmelee, president; S. Scovil, vice-president and treasurer; S. C. D. Johns, secretary, and Robert Lindsay, general superintendent. We are indebted to Mr. Lindsay for data on the plant here given.

ELECTRIC TRANSPORTATION DEPARTMENT.

HOW SHALL THE TROLLEY BE APPLIED ON STEAM ROADS?

We print below a number of additional letters received too late to be added to those in our last issue.

The first and most important question is as to the potential that can be safely employed. Generators can certainly be built and safely operated at 1,000 and, I am convinced, at 1,500 volts. With separately excited fields and large Gramme ring armatures in which the winding itself formed the commutator as in some Siemen's and Halske, and some General Electric generators, or having a separate commutator containing as many strips as there are turns of wire on the armature, I see no reason why a thousand or fifteen hundred volts cannot be perfectly well taken care of at that end of the line. Series wound motors can be built for 1,000 volts, and open coil motors for higher voltages, or two 750 volt motors could be run in series across a 1,500 volt circuit. For long run express service, I believe trains of four or five cars drawn by electric locomotives of ample power will be found to best fulfill all the requirements.

It would be a great gain to electric transmission for railway work if some thoroughly efficient and reliable means could be devised for maintaining the high efficiency of the motor while running the train at varying speeds. This must be done either by changing the counter E. M. F. of the motor or by a gearing permitting of variation of the speed relations between motor and axle. It must not be done by introducing resistance to lower the speed of the motor or by any frictional device or shunted liquid gearing where energy is wasted in friction. Most of the devices proposed for varying the speed relations between motor and car axle have been open to this objection. One method proposed, I am not sure that it was ever tried even experimentally, is theoretically correct, but perhaps might not prove successful in practice. It consists in connecting the electric motor to the car axle by liquid gearing, there being several liquid motors on the car axle through one or more of which the liquid put in motion by a pump driven by the electric motor, could do its work. When all the liquid was forced through one motor a high speed would result, when it was divided between several motors the speed would be slow, but the efficiency of transmission would be as high for the slow speed as for the high. The H. Ward Leonard system provides for economical variation of speed, but on this system a 500 H. P. locomotive must be equipped with 1,500 H. P. in electrical machinery.

In the present state of the art, alternating current motors are not suitable for railway service. They do not lend themselves readily to the varying speed requirements, and they cannot be handled with the same facility as direct current motors.

The best system in my judgment would be a direct current three wire system of not less than 1,000 volts on a side, using the rail as the balancing conductor. For traffic requiring frequent stops, single cars each equipped with its own motors should be run as now on electric roads. Trains of not more than five or six cars drawn by one locomotive, or five or six cars each equipped with its own motors but all handled from one point, would better provide for express service.

Trolley wires should be overhead. They would be in the way of the section men if placed on low posts. I believe there is no question whatever that in the present state of the art, electrically propelled trains, deriving current from central stations equipped with the best high duty engines, can be run more economically than trains driven by steam locomotives, and any improvement that should provide for maintaining a high efficiency with varying speed will give electric propulsion a still greater advantage.

In changing steam railroads to electric, it must not be forgotten that one great advantage of the electric road is in the character of the service furnished. Single cars running at frequent intervals, accommodate the public far better than long trains at long intervals. Such frequent single cars are rendered possible because each car becomes its own locomotive, the operating appliances occupying no room available for passengers. Even for long distance express service trains can with great advantage be shortened and run more frequently.

W. A. Anthony.

New York City.

I think that a single electric locomotive having two or more axles with a motor upon each axle will be made the standard for this class of service. The direct current constant potential system has many advantages, and is the only one that has proven practical in street railway work. The voltage I think will be increased to at least 1000 volts in the first roads that are built, and will probably be increased as the armature and line insulating material becomes more perfect.

The three-wire system can undoubtedly be used with satisfactory results on suburban lines where the trains are very close together, but for long lines and few trains it does not seem to me practicable.

The working conductor on elevated roads can easily be placed approximately on a level with the rails, but for surface work it seems to me essential to place it in the air, similar to the present trolley lines.

Of course there are many complicated forms and systems for building long distance electric roads, some of which have many points of merit, but none of which have been tried, and since you wish "an expression of opinion on the methods which seem most feasible, considering the present state of the art."

B. J. Arnold.

Chicago, Ill.

We believe, with you, that the time has come when electrical equipments will be placed on steam railroads, now operating with ordinary locomotives, for moderately long distances and that the change can be made with economical results, so far as operation is concerned. We have recently taken a number of orders for roads of this kind near Philadelphia, Pa. We have thus far followed the practice of putting motors on long double-truck cars, arranged to operate at a speed of from 35 to 40 miles per hour.

We are providing in some cases, two 50 H. P. motors for such a car, and, where trains are used, two 100 H. P. motors, the motors being placed under a combination baggage and smoking car, with the ordinary passenger coach attached. These cars are provided with air brakes and are easily handled with a special series-parallel controller made amply large to handle the current. We believe this practice the best until we reach very large trains where it may be advisable to use a separate locomotive.

For roads using a moderate amount of power, I believe the over-head trolley will be the safest and best. The three-wire system can be used to advantage on these interurban roads where there are enough motors in operation to keep the sides easily balanced. We are putting in a road of this kind at present about forty miles in length. When we come to use heavy locomotives for heavy trains it will be a serious problem, to place the conductors where they will do little harm and still be mechanically heavy enough to do the work, where the road is on the surface.

I hardly believe it will be safe to put the conductors near the surface of the ground, unless they are enclosed, at least partially, below the surface.

We are making it a special point to work up this large electrical apparatus, and we are already doing considerable business in this line and our efforts in this direction thus far have been very satisfactory. I am glad to see that The Electrical Engineer is taking this matter up with a view to hastening the use of electric motors of large size on cross-country roads. The idea is especially adapted to roads connecting small towns with larger cities and for lines feeding main lines of steam railroads. I believe it would pay the main steam railroad systems of this country to build feeder lines out into the country for both freight and passenger service.

S. H. Short.

Cleveland, O.

THE POWER PLANT OF THE BALTIMORE & OHIO BELT LINE TUNNEL.

The Baltimore Belt Line Road, as it is termed, 7 miles in length, is a short cut connecting the main tracks of the Baltimore & Ohio Railroad at two points, and its object is to avoid a long curve about the city. This is calculated to save from twenty minutes to half an hour in the running time between New York and Washington, and besides it will enable the Baltimore and Ohio Railroad Company to place one station near the present Union Station of the Pennsylvania Railroad, and a second one in the very heart of the business centre of the city. The tunnel is 7430 feet long, a little less than a mile and a half, and cost between $7,000,000.00 and $8,000,000.00.

The motive power is furnished from one station located near the end of the tunnel. This power house is equipped throughout by the General Electric Company. In addition to the traction plant, an electric lighting plant has been installed, which will supply about 2,000 incandescent lamps, placed throughout the tunnel. As there will be no smoke in the tunnel, it is intended to paint its interior white, and when illuminated by the electric lights it will not be necessary to light the lamps in the cars of passing trains, as the passengers will find it almost as brilliant inside the tunnel as outside in the daylight. The generators will be driven by Armington & Sims engines, and the steam will be furnished from improved "Root" water tube boilers. The boiler room of this plant is most interesting, and includes the most modern appliances.

Twelve "Root" Boilers are arranged in six batteries; three batteries on each side of the room. Each of the two flues, which run along the opposite walls, back of the boilers, carries the heated gases to economizers, and by this means, raises the temperature of the feed water. The gases then pass into a fan of the Sturtevant pressure pattern, which expels them through a short stack into the air. This fan establishes an induced draft, causing the air to pass rapidly through the grate bars and coal, thus promoting combustion, according to the speed of the fan, which is regulated by the demand for steam on the plant.

A coal and ash handling device, made by the C. W. Hunt Company, carries the coal direct to each of the boilers, where it is needed, and it also carries the ashes away from the ash pits.

As the General Electric Company are relying entirely upon the success of this plant for their sale of it to the Baltimore & Ohio Railroad Company, they naturally were obliged to exercise the greatest care in their selection of all the appliances. The General Electric Co., before placing their order with the Abendroth & Root Co. thoroughly tested the Root in two of their plants in Lynn, Mass., which are equipped with this make of boilers.

LITERATURE.

Annuaire du Bureau des Longitude. 1895. Paris. Gauthier-Villars et Fils. Price 2 fr.

The present Annual contains a great deal of practical information for the use of astronomers and navigators, as well as articles on the statistics of geography, mineralogy, etc., together with a number of essays by well-known scientists on astronomic and photographic subjects.

Hilfsbuch für die Elektrotechnik. Edited by C. Grawinkel and K. Strecker. 1895. Fourth Edition. Julius Springer. Berlin. Price, $2.50.

Besides a few minor changes which have been made in this Annual, the most marked innovation is the attempt to carry out the system of units in accordance with the resolutions of the Electrical Congress in 1893. As a reference work the Hilfsbuch is one of the most carefully prepared and comprehensive published and is especially valuable for the information it gives on dynamo construction.

Standard Methods in Physics and Electricity Criticised and a Test for Electric Meters Proposed. By H. A. Naber. London. George Tucker. 1894. 5½x8½ inches. 114 pp. Price, $2.00.

This is one of those queer books which occasionally see the light of day, in which the author seems to express a personal grievance against the existing condition of affairs. In this case the grievance happens to be directed against the usual forms of electric meters employed. The author cites many books and papers to show the inaccuracy of nearly all of the present types, and concludes that, all things considered, the gas voltameter is practically the only really scientific instrument to be employed for the purpose. To remedy all the existing evils Mr. Naber proposes a standard laboratory voltameter of his own construction, which is provided with refinements for eliminating all possible errors which that method is subject to.

TELEPHONY.

TELEPHONE NOTES.

Middleport, N. Y.—Middleport is to have a telephone exchange.

Union, S. C.—W. D. Arthur will establish a telephone line and exchange.

Trenton, Mo. will have a telephone system when 100 subscribers are pledged.

Atchison, Kan.—The Western Telephone Company of Atchison has taken out a charter.

Morristown, Tenn.—J. B. Cox, of Knoxville, intends to establish a telephone system.

Valdosta, Ga.—J. D. Whitlaw is endeavoring to secure the establishment of a telephone line.

Wausau, Wis.—A movement is on foot to establish an independent telephone system and to connect with neighboring towns.

Mansfield, O.—The People's Telephone Company contemplate extending their line from Lexington to Mansfield in the near future.

Saugerties, N. Y.—The West Shore Telephone Company, now putting up wires in Kingston, talk of extending their line to this village.

Snow Hill, Md.—A movement is on foot to establish a telephone line between Snow Hill and Pocomoke City. A large number of subscribers have been obtained.

Salem, Mass.—The Columbia Telephone Company of New York announces that it has secured the necessary backing and is to start a telephone service in this state, beginning at Salem.

Jefferson City, Mo.—A certificate of incorporation has been issued to the Missouri Telephone Manufacturing Company of St. Louis; capital $2,000. Incorporated by I. J. Kusel, Russell Parker and C. L. Chapman.

Atchison, Kas.—The Western Telephone Company have received their charter. The officers are: F. M. Baker, president; J. W. Sharrard, treasurer; M. J. Travis, secretary; Dr. Miller and E. D. Mills, directors.

Taylor, Tex.—Mr. Joe A. Marro of Austin, Tex., representing the Southwestern Telegraph and Telephone company, is in the city soliciting subscriptions to a telephone service and arranging to put in a plant here at once.

Owosso, Mich.—The Harrison Telephone and Telegraph Construction Company of Michigan have asked Owosso for a franchise allowing them to erect poles, etc., in that city for the purpose of operating an exchange.

St. Louis, Mo.—The Individual Telephone Directory Company of St. Louis was incorporated with a capital stock of $3,000, of which one-half has been paid. The purpose is "to print, publish, sell and dispose of books and advertising matter."

Syracuse, N. Y.—The Central New York Telephone and Telegraph Company has purchased the Goodwin property. A large fireproof building of iron, stone and brick and four or five stories in height will be built on the lot for the exclusive use of the company.

Greensburg, Pa.—The local telephone company has organized under the name of The Westmoreland Telephone Exchange, with the following officers: President, J. C. Crownover; treasurer, John D. Miller; directors, W. S. Lane, J. K. Clarke, E. H. Bair, D. C. Ogden and J. C. Crownover.

St. Louis, Mo.—In the Senate Mr. Klene of St. Louis has introduced a telephone bill fixing annual charges at 60 for cities over 25,000 inhabitants, 30 per annum in cities under 25,000 and five-minute conversations with Suburban points 25 cents. It is expected that the Bell Telephone Company will fight the bill.

Penn Yan, Pa.—"The People's Telephone Company" is a new organization which A. V. Masten, Jr., is endeavoring to engineer to a successful consummation. It is proposed to capitalize the company at $10,000, and transact business in the central New York counties, with headquarters in this village.

Johnstown, O.—The Johnstown Telephone Company has been organized by the election of the following board of directors: George Kreuger, James P. Thomas, Dr. W. B. Lowman, P. S. Fisher, H. H. Weaver, George Brown, Charles Griffith, F. J. Devlin and Dr. C. E. Hannan. The new telephones will be rented for $1 and $2 per month.

Bay City, Mich.—The fight for supremacy between the Anthony, Harrison and Standard telephone companies for the right to erect poles and wires in this city has been won by the former. The price of telephones is to be as follows: Residences, $24; professional offices, $25; business houses, $30; Saginaw connection, $5 additional. All instruments are to be long distance. All charitable institutions are to be given free service.

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CONTENTS.

CENTRAL STATION OPPORTUNITIES.

THE meeting of the National Electric Light Association in Cleveland this week is of special and peculiar interest for many reasons. It is strange that the Association has never gone to Cleveland before, but there is none the less a fitness in going there at the beginning of its second decade. The data which we publish in this issue as to the electrical history and industries of Cleveland shows that the city is even better able to meet the demands of the next ten years than it has been those of the last ten. The old factories remain active and aggressive, while the new are ready to meet the latest necessities of the art.

The Association began its career ten years ago with the definite, if not avowed, intention of promoting chiefly the interests of arc lighting. At that time few if any arc lighting companies had any other business than that of operating high tension arc lamps, but they very soon began to seek for other opportunities of utilizing current, and were not slow to lose the attitude of hostility assumed in many instances toward the incandescent light. Then came the process of consolidating companies and the consequent blending of various systems, so that at the present day, managers who started on their careers with a few strings of arc lamps, find themselves operating arc machines, incandescent machines, power generators and often railway circuits. In fact the whole aspect of the electric lighting field has changed in these ten years. It may be said, broadly, that stations have ceased to sell light; what they now deal in is current. The truth of our statement is emphasized by the fact that in one leading city, the current furnished for power is practically 40 per cent of the load; while in another city, 250 elevators aggregating 3,000 H. P. draw current daily from the mains laid down for lighting.

Now it seems to us that these examples are by far less frequent than they should be, and that, the tendency of the times being so evident, it should be the aim of central stations to encourage it. To say nothing of many new electrical applications that still linger imperfect for want of a ready supply of current, there are now plenty of others from which income may be legitimately derived based on the sale of current. It is true that single motors will be found in use here and there in a city, but the number is still small of whole shops and factories supplied with current from central stations. Elevator work also has not been pushed as it might be, except in such striking individual stations as that cited above. Then, too, in electric heating and cooking; we doubt if any station yet has a load of that character of the minutest kind, although the apparatus on the market is certainly excellent and sure of speedy improvement where found defective or uneconomical of current. People want these appliances and will buy them if properly coaxed. Another branch in which nothing has been done is that to which we have once or twice directed attention, namely, the use of high tension electrolyzing apparatus, on the incandescent circuits, for the purpose of supplying houses and offices with an abundance of purifying fluids. Such apparatus has actually been built, and must find a market, as also will that on a larger scale for stables, garbage grounds, ren-

dering establishments and the like, all needing only a good and cheap supply of current which any central station equal to its opportunities should now be able to afford.

With motors now so good and moderate in price, no station should fail this year greatly to increase its power load, for running machinery, ventilating fan work, &c. Moreover it has been shown that with dynamotors, stations can supply current for the local telegraph offices, telephone exchanges, fire alarm plants, &c., and can also charge storage batteries for electric launch work, and other branches of the art. None of the things we have mentioned are in any degree fanciful. They are all practical and within reach.

Just what the second ten years of the Association will bring forth, we are not prepared to say. The lines of work may change greatly. Without prophesying, we will venture to express our belief that it will see phosphorescent lighting established as an art, and the whole method of producing and utilizing current tremendously simplified and cheapened. They who are now in the field should be the first to derive benefit and profit from the advances to be made.

TELEPHONIC EPISODES.

It is stated that where the circumstances have demanded it recently, the exchange rates of the "old line" local Bell Telephone Companies have been reduced as low as $12 and $18 a year, a price so absurdly small that no competition could possibly make headway against it. When it is remembered that of the money received by the local company, a certain proportion pro rata goes to the parent company in Boston, it will be seen, first, that if the plan were carried very far, there would be a cessation of the large dividends of the last few years; and, secondly, that both the parent and local companies are ready at once to sacrifice current income for the sake of maintaining their hold on the future development of the exchange industry.

This state of affairs we predicted as likely many months ago, in pointing out that the now dead Berliner patent was but one of the Bell weapons of defence and offense. Moreover, it would now appear that the Western Electric Company is protecting the private line and isolated plant branch of the telephone business by a series of suits, which may be instituted to harass, but which are all based on alleged infringement of certain specific detail patents. In addition to this, some of the new competing companies appear to be already fighting among themselves; so that the roseate prospects of a free, open field, with plenty of orders and fat profits, is painfully slow of realization. It seems to us, nevertheless, that the Bell companies are playing with fire when for the sake of debarring a competitor they treat the public to rates far below the cost of service.

PHOSPHORESCENT LIGHTING.

One can now-a-days scarcely take up a journal, either scientific or lay, without reading some account of work done in, or speculation upon, the attempt to generate an improved artificial light,—one that will afford illumination direct without the wasteful accompaniment of heat and which will approach in efficiency that of the glow worm whose light has been shown to be of almost perfect economy. The methods which have been applied for carrying out this work have varied in detail and have generally involved high frequency or high potential, or both. It would seem however, that there are still other methods open to investigators and it was our pleasure to witness last week an exhibition of such an one embodying the work of Mr. D. McFarlan Moore.

The line Mr. Moore has marked out for himself contemplates the introduction of phosphorescing glow lamps on continuous or alternating current circuits of ordinary potential with the addition of but the simplest auxiliary apparatus. While no quantitative measurements have yet been made which would afford an approximate basis of comparison between the respective efficiency of this method, and that of others, we are nevertheless justified in asserting that Mr. Moore has succeeded in producing light effects in a way which is, to say the least, promising and which it is to be hoped, will be prosecuted to a successful issue at an early date.

The exigencies of patent applications now pending prevent us unfortunately from giving the details of the methods employed by Mr. Moore for the present.

THE HAWAIIAN CABLE.

Many months ago it was pointed out in these pages that whatever might be the future status or ownership of the Hawaiian Islands, a cable connecting them with these shores was extremely necessary. The recent events in the Ever-Turbulent Isles has made it desirable that the cable should be laid as soon as possible, whether for its own utility or as a link in the future great cable system of the Pacific. History is being made at a rapid rate in that part of the world, new racial, diplomatic and commercial conditions are pressing forward for settlement in some shape, and it is evident that even an expensive cable will be a cheap investment. Under these circumstances, the proposed expenditure by this country of $500,000 for the preliminary work of constructing the proposed Hawaiian cable will probably be acquiesced in. There are some decided objections to the outlay, but there are many advantages, and as practicable routes have already been surveyed, there is no reason why the work should not go ahead. The total cost is put at about $3,000,000, though it is likely to be $4,000,000; while a branch to Japan ought also to be planned at the same time, for the sake of our important relations with the friendly people of a country anxious to do a larger trade with us. When the cable is laid, we shall all wonder that it was so long dispensed with, while the Atlantic was overburdened with a round dozen, fighting each other desperately for business. When it is laid also, it is to be hoped that the Hawaiian nuisance will be laid at the same time.

As we go to press, the news reaches us that the New York, New Haven & Hartford Railroad has made a contract with the General Electric Co. for the first part of its equipment with electric motors. This change from steam to electricity has already been discussed in our pages. Its importance cannot be overstated. The next step will be the conversion of a whole steam railway system; and that step is not far off.

MISCELLANEOUS.

THE ELECTRIC ARC.—II.

BY HERTHA AYRTON.

The following table gives the results of the actual measurements made of the diameters, for each current, with the 2mm. and 4mm. arcs, side by side with the diameters calculated from the formulæ

$$D = 3.2 + 0.162\ A, \text{ for the 2mm. arc,}$$
$$D = 3.2 + 0.172\ A, \text{ for the 4mm. arc,}$$

D being the diameter of the crater in millimetres, and A the current in amperes. The coefficients given here of A are somewhat higher than those stated in the last article; but those, I find, were a little too small to produce the best agreement between the formulæ and the results obtained experimentally.

Carbons: Positive, 18mm. cored. Negative, 11mm. solid. Length of arc, 2mm. silent.

Current in amperes.	Measured diameter of crater in mm.	Calculated diameter of crater in mm.
4	3.8	3.85
7	4.2	4.33
10	4.75	4.82
15	5.6	5.63
20	6.45	6.44
25	7.25	7.25

Length of arc, 4mm. silent.

Current in amperes.	Measured diameter of crater in mm.	Calculated diameter of crater in mm.
7	4.4	4.404
10	4.9	4.92
15	5.8	5.78
20	6.6	6.64
25	7.6	7.5

For all currents, therefore, between a comparatively small one and the largest that will give a silent arc the *diameter* of the crater may be expressed with surprising accuracy as a linear function of the current.

The curves in Figs. 4, 5 and 6 (pp. 142 and 143, THE ELECTRICAL ENGINEER Feb. 13), for the three pairs of carbons may be employed to ascertain what must be the resistance of the extra coil used with an arc lamp, and what is the potential difference necessary to be maintained between the mains, in order to produce a *silent* arc of given length with a given current.

From the curves in Fig. 5 we see that the resistance added to an arc lamp on a constant pressure circuit fulfills two objects. It not only prevents the current from becoming very large when the carbons are in contact before the arc is struck, but it fulfills another very important function in making it possible for a solenoid to regulate the length of the arc, and keep the current passing through the arc approximately constant, by causing the feeding mechanism to approach the carbons together when the current falls below the required value.

For if there were no added resistance coil, and the only resistance in the lamp, beyond that of the arc itself, were the very small resistance of the regulating solenoid, the potential difference between the carbons would be practically constant when the lamp was attached to constant-pressure mains. In that case we see from the curves in Fig. 5 that if the arc were, say, 3 mm. long, and the current were, say, 13 amperes, the burning of the carbons would *increase* the current, so that the regulating solenoid would have to start the feeding mechanism when the current became too *large*, and not when it became too small, as with the regulating solenoid of an ordinary arc lamp.

But even if the regulating solenoid were constructed so as to start the feeding mechanism when the current became too large, such a lamp could not be satisfactorily used with a constant potential difference between the carbons—that is, without an added resistance on a constant-pressure circuit. For a length of arc of about 1.8 mm. is not uncommon in arc lamps, and at about this length, a small increase in the length of the arc may cause either a great increase or a great diminution in the current for a constant potential difference between the carbons, depending on whether the length of the arc is greater than, or less than, the length corresponding with the point of intersection of the curves.

The addition of a resistance to an arc lamp on a constant-pressure circuit is necessary to make it possible for an electromagnetic mechanism to regulate the distance between the carbons. This explains the curious fact noticed by Prof. Ayrton when giving the lecture on "The Storage of Energy" at the London Institution on March 3, 1882. A Foucault-Dubosq arc lamp, which regulated perfectly well when supplied with current from Grove's cells without any interposed resistance, refused entirely to regulate when the Grove cells were replaced by a battery of Faure accumulators, although the number of accumulators was chosen to set up the same potential difference between the lamp terminals as was produced by the Grove's cells. He had, in fact, replaced a circuit of constant E. M. F. by one supplying constant pressure, and with the latter the distance between the carbons oscillated backwards and forwards between two wide limits, the regulating mechanism, which both approaches and recedes the carbons in a Foucault-Dubosq lamp, vainly trying to find a position of stability. The length of the excursion up and down of the carbons in such a case can be calculated from the curves which will accompany the next article.

CONTRIBUTORY INFRINGEMENT OF PATENTS.[1]

BY HUBERT HOWSON.

CONTRIBUTORY infringement of a patent right may be defined as the intentional aiding of one person by another in the unlawful making or selling or using of the patented invention. The doctrine or judicial law of "contributory infringement," considered as a settled doctrine, is comparatively modern; less than twenty-five years ago it was an unknown term. When Curtis published the third edition of his book on the law of Patents in 1867, he had nothing to say on "contributory infringement." When he published his fourth edition in 1873, he inserted in his book a new section of two pages devoted mainly to quotations from the first reported opinion, which may be said to have laid the foundation for the whole modern doctrine on this subject.

When this term "contributory infringement" is used, one naturally thinks at once of that form of it which consists in one person's supplying to another a part of a patented combination with the intent that that other may make up and sell or use the whole combination. It was in such form that the question first came before the Courts in 1871 and 1872.

In the fall of 1871, Judge Woodruff in Connecticut, had before him the now leading case of *Wallace & Sons v. Holmes, Booth & Haydens*,[2] involving the simple but then novel state of facts, which are sufficiently explained in the following quotations from the opinion of the Court:—

"The complainants having a patent for an improved burner in combination with a chimney, the defendants have manufactured and sold extensively the burner leaving the purchasers to supply the chimney without which such burner is useless. They have done this for the express purpose of assisting, and making profit by assisting, in a gross infringement of the complainants' patent. They have exhibited their burner furnished with a chimney, using it in their sales-rooms to recommend it to customers and prove its superiority and therefore as a means of inducing the unlawful use of the complainants' invention, and now it is urged that, having made and used burners only, they are not infringers, even though they have distributed them throughout the country in competition with the complainants and have to their utmost ability, occupied the market, with a certain knowledge that they were to be used as they can only be used, by the addition of a chimney. * * * The defendants are therefore active parties to the whole infringement, consenting and acting to that end, manufacturing and selling for that purpose."

It will be quite clear from the foregoing quotation that although the question presented to Judge Woodruff was entirely new, he had no hesitancy in reaching the conclusion that the defendants were infringers, but when a similar question was presented to Judge McKennan in the Eastern District of Pennsylvania, in the spring of the following year (1872) in the case of *Keystone Bridge Co. v. Phœnix Iron Co.*,[3] it seems as if the Court reached the opposite conclusion from that arrived at by Judge Woodruff. It is not by any means clear however, that this Bridge case, as presented and argued, was "on all fours" with the lamp burner case.

The ruling in the case of *Wallace v. Holmes* was quickly recognized as authority. In the latter part of 1872, in the case of *Renwick v. Pond*,[4] a suit on a patent for a cartridge-extracting mechanism for firearms, Judge Blatchford approved the ruling of Judge Woodruff. In another case[5] in 1876, the patents in suit were for improvements in children's carriages, the distinguishing feature in both being the connection of the top of the carriages with movable and adjustable standards, so that the top could be adjusted and fastened in any required position. The defendants made only the standards for the carriages "but it is admitted that they are made and sold to carriage builders for the express use to which they are put, that is, to children's carriages, and it is not denied that this in law makes them infringers." In another case[6] on the patent for the well-known Holly system of waterworks, the defendants seem to have only supplied the pump for the system, but the Court said: "The effect of the whole (answer and evidence) clearly is that they participated in putting in the whole by furnishing the pumps for that purpose, and this is sufficient to make them liable as infringers."

The doctrine of "contributory infringement" is of course no exception to the general rule that a patent for a combination of elements is not infringed unless the whole combination be

1. Abstract of a paper read before the American Association of Inventors and Manufacturers, Washington, January 15, 1895.
2. 1 *Off. Gaz.* 117.
3. 1 *Off. Gaz.* 471.
4. 2 *O. G.* 392.
5. *Richardson v. Noyes*; 10 *O. G.*, 507.
6. *Holly v. Machine Co.*, 4 *Fed. Rep.* 74; 18 *O. G.* 1177.

employed. It is only when, and because, a defendant has supplied a material part with the knowledge or intention that it is to be used in making up the whole combination, that he becomes a contributory infringer.

It is generally recognized now that this doctrine of "contributory infringement" is founded upon a well-settled rule of law. The principle may be roughly stated that he who wilfully assists in a wrongful act, becomes answerable for all the consequences of that wrongful act,—is himself a wrong doer. An infringement of a patent right is a "tort," as it is termed, that is, (to express it generally), a wrongful act, for which an action will lie. Therefore any one who intentionally contributes to or assists in an infringement of a patent right, thereby makes himself answerable for that infringement—is himself an infringer.

The cases to which I have alluded are cases in which the patents were for combinations, but there are many reported cases of contributory infringement of patents for *processes*, by supplying the materials therefor. Thus, as early as 1876, Judge Nixon in the New Jersey District, in the case of *Rumford Chemical Works v. Hecker*[7], held that Hecker (of Buckwheat fame) in selling his self-raising flour, and advertising it as "an invaluable article for producing in a few minutes by addition of cold water only, without yeast or salt, the most nutritious and wholesome bread," was an infringer of a patent of Prof. Horsford for the use of phosphoric acid when combined with alkaline carbonates as a substitute for ferment or leaven in the preparation of a farinaceous food, and the ground for the decision was that this flour contained the ingredients mentioned, so that when the cook should make the flour into bread in the usual way, the process would necessarily be carried into effect. Again, where a dealer in photographic supplies, who was himself licensed to sell the materials to the licensees of the platinotype photographic process, sold the materials to other persons known not to be licensees, he was held to be an infringer.[8]

In still another case[9] the complainant owned the Cooley patent of September 1879 for "a new process of raising cream from milk." The defendant made and sold milk cans adapted to be used according to the Cooley process and they were sold with directions for such use. Defendant very naturally contended that as he only made a mechanical device, he could not be held to infringe a patent for a process. Nevertheless the Court held that as the defendant's cans were to be used only for the purpose of raising cream in the manner described by the Cooley process and were sold with directions for such use, the fact of infringement was established.

It is scarcely a matter of surprise to find that this doctrine of contributory infringement had hardly got well under way before patentees were anxious to carry it beyond the limits of the principle upon which it is founded. The principle requires an intention on the part of a defendant to participate in the act which constitutes the infringement. As early as 1874, in the case of *Coolidge v. McCone*[10] where the complainant sought to have defendant enjoined as an infringer of a patent for a combination of shoes and dies and bevelled bars in an amalgamating pan for silver ores, the Court held that as there was no evidence of any intention on the part of the defendant to supply the shoes and dies for the purpose of making up the complete combination by the addition of the "bevelled bars" by the users, he was not a contributory infringer.

This necessary element in contributory infringement of an *intention* to so contribute to the infringing act was expressed by Judge Shepley in the following lucid language as early as 1875:

"As the defendants only make one element of the patented invention, in order to hold them guilty, I must find proof connecting them with the infringement. Different parties may all infringe, by respectively making or selling, each of them, one of the elements of a patented combination, provided those separate elements are made for the purpose, and with the intent, of their being combined by a party having no right to combine them, but the mere manufacture of a separate element of a patented combination, unless such manufacture be proved to have been conducted for the purpose and with the intent of aiding infringement, is not, in and of itself, infringement.[11]

By this is not meant that the party must have known of the patent and intended to infringe it. If he intentionally contributed to the *act*, which the Court holds to be an infringement of the patent, he is an infringer, and his actual lack of knowledge of the existence of the patent will not excuse him. The publication of patents is assumed in law as to be sufficient notice to the public of their existence.

Bearing in mind the principle of law upon which this doctrine of contributory infringement is based, it will not be difficult to perceive that there may be other ways in which one can contribute to an infringement of a patent right. An interesting case[13] of contributory infringement was decided by Judge Blatchford in 1879. It consisted in the transportation by the Old Dominion Steamship Co. of cotton ties from New York to various southern ports, knowing that such ties were intended for sale and use in southern cotton ports and elsewhere. The Court said:—

"It would seem, on principle, that there ought to be no difficulty in restraining by injunction all persons, whether officers of the company or not, who are aiding in the promotion of the infringing sale and use, whether such persons would be liable for profits or damages or not."

When the term "contribution" is used in ordinary conversation, it suggests "passing around the hat," and in point of fact that is one way in which you may contribute towards an infringement. In a case of *Bate v. Gillett*[14] the Court had granted an injunction against the Gilletts enjoining them from infringing the plaintiff's patent. They immediately ceased to make use of the complainant's process for preserving meat, but afterwards they entered into an agreement with others, to contribute to a fund for a common defence against all infringement suits which should be thereafter instituted by the complainant against any one of the parties. Suit was brought against one of the parties and the expense of defending that suit was or was to be, paid out of the common fund, and it was shown that these defendants paid their proportional share of money to the fund.

"Such conduct is in disobedience of the injunction in its spirit, if not in the letter. They are doing, indirectly, what they have been commanded not to do either by themselves or through the agency of others * * * * *—Where it is proved that what a party does is done for the purpose and with the intent of aiding infringement, he is liable under the doctrine of contributory infringement."

Finally, contributory infringement may take on more of the nature of a conspiracy than is suggested in the cases to which reference has been made. In the comparatively recent case of *Waterman v. Shipman*[15], decided by the Circuit Court of Appeals in New York, the bill of complaint alleged a combination between the defendants to deprive the plaintiff of the benefits and advantages of his license. Waterman had the exclusive license to manufacture under the patent in suit. One of the defendants, Asa L. Shipman, afterwards acquired the legal title to the patent, and undertook to give his sons, the co-defendants, a license. The Court said:—

"If the licensee's rights have been infringed by the owner, and third parties confederating with the owner, there is no reason why all the infringers should not be joined as defendants." * * * * * * The evidence shows that the license granted by Asa L. Shipman to his sons, the other defendants, was granted by him, and procured by them, for the paramount purpose of preventing the complainant from enjoying the monopoly conferred by his license. The defendants, therefore, are joint infringers."

Many other reported cases might be cited to elucidate the subject, but what has been said will serve to make it clear to you that you may infringe a patent not only by directly making or selling or using the patented invention yourself without a license, but also by intentionally aiding any one else in any such unlawful act.

THE ELECTRIC LIGHT IN CONGRESS.

REPRESENTATIVE Linton from the Committee on Ventilation and Acoustics in the lower house of Congress has submitted the following report concerning the ventilation and lighting by electricity of the House of Representatives:

The Committee on Ventilation and Acoustics, to whom the matter of ventilation of the House of Representatives was referred, beg leave to report that the testimony of the experts from the Supervising Architect's Office and the Marine Hospital Service proves most conclusively that the present method of lighting the south wing of the United States Capitol is one of the principal causes for the existing impure condition of the air throughout that portion of the building referred to. Mr. Adams, heating and ventilating engineer of the Supervising Architect's Office, says:

"In addition to this it will be almost imperative to substitute electric light for gas light, especially for lighting the Hall; this will remove one of the dangerous sources of impurities in the air. If a suitable electric light plant is installed, the heating of the entire building can be so arranged that it will practically cost nothing, as the exhaust steam from the electric light and fan engines will be more than sufficient to heat the same."

Dr. J. J. Kinyoun, of the Marine Hospital Service, says:

"There are leaky gas pipes in the building, especially in the cellar. In one instance 0.7 part per 1,000 was detected, the quantity of gas present depending upon how long the building had been closed and the ventilating machinery stopped. The system of lighting the hall is open to a serious objection due to the escape of gas from the numerous gas jets over the ceiling. The electric light plant should be enlarged sufficiently to supply all parts of the building with electric lighting. This alone will add much to the sanitary condition of all parts of the building."

The committee further recommend that the Committee on Appropriations cause to be inserted in the Sundry Civil Bill or deficiency appropriation bill of this session an amount, not exceeding $70,000, for the purchase of an electric plant, and to place in operation facilities for carrying out the objects of this Congress to perfect the ventilation and acoustics of the House of Representatives.

BRISTOL, TENN.—It is now quite certain that Bristol will have a new telephone exchange company, as a rival of the East Tennessee Telephone company, which has an exchange there.

7. 2 *Banning & Arden*. 351.
8. *Willis v. McCollin*, 29 *Fed. Rep*. 641; 38 *O. G*. 1017.
9. *Boyd v. Cherry*, 50 *Fed. Rep*. 279
10. 5 *Off. Gaz*. 458.
11. *Saxe v. Hammond*, 7 *Off. Gaz*. 781.
13. *Am. Cotton Tie Co. v. McCready*, 17 *O. G.*, 565.

14. 30 *Fed. Rep*. 683. 15. 55 Fed. Rep. 982.

LETTERS TO THE EDITOR.

IMPROVEMENTS IN RAILWAY MOTORS.

In electric machines there are numerous things which tend to decrease the efficiency; they are generally considered inherent defects. I have in mind now more particularly electric railway motors, and beg leave to refer to some efforts of mine, aimed to simplify and improve their construction. The details and advantages are more specific in the patents to which reference is made. Patent No. 532,782 of January 22, 1895, refers to a magnetic brush holder.[1] The scheme is to vary the pressure of the carbon brushes against the commutator by the current used. When a car is descending grades or coming to a stop, there is no pressure against the brushes and commutators. When the car is running fast the pressure is light. While the main object is to prevent wear on the vital parts of the machine, its application to railway motors would materially increase their efficiency.

In double reduction machines, where the commutators are about two feet in circumference and the speed of the car is 20 miles per hour, with a brush pressure of 12 pounds, the pressure against the commutators figures over 20,000 foot pounds per minute. The actual loss of energy is variable with different conditions, depending upon the relative smoothness of the commutators and the lubrication the brushes. To those who are familiar with the sound of screeching brushes this loss will be appreciated as being very considerable.

Patent No. 516,807 of March 20, 1894, relates to a method of constructing armatures and connecting the commutators thereto. In, say, a sixty section armature, at least two and sometimes four of the adjacent coils of the armature are short circuited by the brushes, so that, instead of assisting, those coils are generating a current, and the motor is consequently retarded by this effort. This induced current is what usually causes sparking at the brushes. In the scheme referred to, the commutators are not soldered but simply have a superficial spring-pressed contact, directly against the armature wires. The commutator is removed or connected with a single nut on the armature shaft. This superficial contact increases the resistance in the bottled up coils, where the E.M.F. is but probably less than seven volts. Consequently, the retarding effect and sparking is materially decreased, while the loss from the superficial contact is insignificant, under 450 volts potential, that is, that received from the line.

Patent No. 520,780 of June 5, 1894, refers to a method of regulating motors. In it all external resistance is avoided. The flashing at the contacts is infinitesimal. The fields are wound with a multiplicity of parallel conductors all connected together at one end. The other ends are joined together at the will of the motor-man. The resistance of each strand is great enough to cut down an injurious amount of current, while the resistance of the combined strands is low enough to magnetize properly the field magnets.

J. C. HENRY.

PERSONAL.

MR. R. B. WOOLSEY has resigned as superintendent of telegraph on the Vandalia lines.

MR. W. H. BROWNE, well known in New York electrical circles as manager of the United Electric Light & Power Co. has been appointed general manager of the Royal Electric Co. of Montreal. Mr. C. W. Hagar, who retires from that position will, it is said, go into the insurance business.

MR. ANDREW PINKERTON, who since his arrival in this country last year has been engaged in the laboratory of the Apollo Iron & Steel Co., Apollo, Pa., has now been put in charge of the electrical department known as the Apollo Electric Light, Heat & Power Co. Mr. Pinkerton is a young Scotchman of considerable ability and energy, and under his care the plant is in good hands.

LEGAL NOTES.

TELEPHONIC LITIGATION.—INTERIOR TELEPHONE CO. vs. TUCKER ELEC. MFG. CO. ET. AL.

The Interior Telephone Co. of New York began suit on Feb. 12 in the U. S. Circuit Court of the Southern District of New York against the Tucker Electrical Manufacturing Co., also against J. R. Strong, president of the company, and T. McCoubray, as individuals, for the alleged infringement of patents granted to Frank R. Colvin and owned by the Interior Co., relating to telephone transmitters. The numbers and dates of these patents are 513,305 of Jan. 23, 1894, and 524,524 of August 14, 1894.

1. THE ELECTRICAL ENGINEER, Feb. 6, 1895.

REPORT OF THE SOUTHERN NEW ENGLAND TELEPHONE CO.

The annual report of the Southern New England Telephone Company shows the following: Assets, franchise, $175,000; construction, $1,959,747.84; supply department, $62,671.16; real estate, $128,691.68; stock and bonds, $302,500; sundry reserve, $6,533.96; accounts receivable, $50,376.20; cash, $12,474.55; total, $2,395,797.89. Liabilities, capital stock, $1,500,000; debt, $831,-173.71; reserve, $12,462.56; surplus, $52,151.62; total, $2,395,-797.89. The business for the year is shown by the following statement: Earnings, exchange service, $375,116.28; tolls, $80,243.12; private line, $6,526.57; metallic circuit loop, $3,721.32; real estate, $7,489.80; miscellaneous, $1,375.16; total, $474,472.25. Expenses, general expense, $60,050.13; operating, $88,250.65; maintenance, $119,424.34; rental and realty, $69,665.96; real estate, $906.75; interest, $38,874.75; dividends paid, $74,870; total, $452,142.62; net gain of surplus, $22,319.63; construction account, $147,226.29. The company has 5,144 subscribers and 5,536 stations.

TOWER LIGHTING FOR AUSTIN, TEX.

The oldfashioned tower system of electric lighting, such as can still be seen on the Public Square, Cleveland, is being put in at Austin, Tex., as a part of the municipal lighting plant. The adoption of this system is somewhat surprising after its abandonment and disuse in several other cities. The objections raised by cities which tried towers were that it was impossible to distribute the light uniformly. Wherever there were buildings of much height or shade trees, these always cast intense shadows. The theory of towers seems to be that they will diffuse a light everywhere, like the sun, but it appears to be impracticable to put up lights high enough and strong enough to do this where there are obstructions to cast shadows.

THE TEMPERATURE OF THE ELECTRIC ARC.

In a communication recently made by M. Violle to the Académie des Sciences, he remarks, says the London *Electrician*, that M. Moisson had in a previous Paper pointed out that it appeared as if the temperature of the *arc* increased with the current. M. Violle's own experiments with arcs of 1,000 to 1,200 amperes support this view. Photographs of the *crater* showed that its intrinsic brilliancy was the same with 1,000 or 1,200 amperes as with 10 amperes. Examining the spectra of the *arc* and of the positive carbon, M. Violle found a large number of the bands of the spectrum of the *arc* stood out brilliantly against the continuous spectrum of the crater; they were, however, unsteady and varied in brightness, being brighter the greater the current. M. Violle points out that we may well doubt the unreserved applicability of the laws of Kirchoff to this particular case. It is doubtful whether the brilliancy of the bright bands forming the spectrum of a gas are related to its temperature in the same way as are the corresponding portions of the continuous spectrum of a solid body. The doubt is increased when the gas is illuminated under the action of electricity, which seems capable of converting itself into light without heat. On the other hand, if the *arc* behaves like a conductor carrying a current it must be the seat of an evolution of heat proportional to the energy consumed, so that its temperature should increase with the current. In any case the cause which limits the temperature of the crater does not apply to the *arc*. M. Violle tried to determine the temperature of the *arc* by introducing into it a thin rod of carbon. A carbon rod introduced into the *arc* produced between two poles of the same metal burns away differently with different metals, slowly with copper, quickly with zinc; showing, however, a much higher temperature than that of the volatilization point of zinc. M. Violle points out that it may very well be that in a Geissler tube a very high temperature may exist, the smallness of the mass concerned making the thermic effect inappreciable. M. Violle concludes that the temperature of the *arc* is, generally speaking, higher than that of the positive carbon, and that it increases with the energy consumed.

UNDERWRITERS REGULATIONS.

The Electric Appliance Company have just published and distributed a copy of the Rules and Regulations of the National Board of Fire Underwriters in neat and convenient form for ready reference. Inasmuch as these regulations are now required in all the large cities, and a majority of the smaller ones, it is very necessary that every one in the electrical business should be familiar with them. The Electric Appliance Company have a number of extra copies and will be pleased to send them on application.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEB. 12, 1895.

Alarms and Signals:—

Electrical Time-Alarm, W. Wilke, Wermelskirchen, Germany, 533,979. Filed Aug. 7, 1894.
An automatic guest call.

Alarm Device for Mills, C. L. Judge, Austin, Pa., 534,158. Filed Nov. 5, 1894.

Fire-Alarm Apparatus, S. W. Ludlow, Madisonville, Ohio, Reissue, 11,471. Filed Jan. 19, 1893.
A thermostatic system making use of the gas pipe system in buildings. The alarm is caused by the increase of pressure due to abnormal heat.

Batteries:—

Electric Battery, J. M. Wells, Peoria, Ill., 533,936. Filed July 31, 1893.
A combined battery and induction coil in which the battery strength is varied by tilting at various angles so as to bring more or less of the electrolyte in contact with the elements.

Galvanic Battery, W. P. Freeman, Brooklyn, N. Y., 534,086. Filed June 11, 1894.
An improved type of multiple cell battery.

Clocks:—

Synchronizer for Clocks, H. S. Prentiss, Elizabeth, N. J., 533,919. Filed June 30, 1893.

Distribution:—

Induction Converter, T. A. Edison, Llewellyn Park, N. J., 534,206. Filed May 21, 1888.
A continuous current transformer. Designed especially to avoid the necessity of rotating such heavy parts as the armature. Employs a stationary field coil and a stationary armature with two coils, the field coil and one armature coil being connected in multiple arc to a source of current by means of commutators. The second armature coil is connected to the consumption circuit.

Dynamos and Motors:—

Alternating-Current Dynamo-Electric Machine, A. Ekstrom, Lynn, Mass., 533,873. Filed July 26, 1894.
A part of the current is commutated for excitation with a shunt around the commutator; a second auxiliary of considerable capacity is inserted between one terminal of the armature winding, the collecting ring and the commutator by which the larger portion of the current is carried direct to the collecting ring without passing through the commutator or the outside shunt.

Apparatus for Winding Armature-Coils, H. Geisenhöner, Schenectady, N. Y., 533,885. Filed Aug. 24, 1894.

Armature-Winding, D. P. Thomson, Schenectady, N. Y., 533,930. Filed Aug. 4, 1894.
A method of cross connecting to reduce the potential between successive bars.

Dynamo-Electric Machine, E. Thomson, Swampscott, Mass., 533,931. Filed Dec. 22, 1890.
A constant potential machine regulated for changing speed.
Claim 4:
A dynamo electric generator having three compound magnetizing circuits, one of the main circuit and in series therewith, another from a shunt circuit having a substantially constant influence, and a third from a circuit the variations of the current in which are due primarily to a structure more sensitive to speed changes than the main machine.

Dynamo-Electric Machine, R. Fuller, Detroit, Mich., 534,038. Filed Oct. 20, 1894.
The dynamo has two armature windings and two commutators, shunt and and series windings on the field magnets, a strip connecting the series windings in series, and a neutral wire connected to the strip.

Armature for Dynamo-Electric Machines, H. F. Parshall, Schenectady, N. Y., 534,079. Filed Feb. 20, 1894.
The armature is constructed in two parts one a stationary iron core, and the other a revolving coil specially mounted and surrounding the stationary core.

Alternating Current Motor, R. H. Hassler, Pittsburg, Pa., 534,151. Filed Nov. 30, 1894.
Claim 1:
The method of starting an alternating current motor which consists in causing the current in the main primary coil to induce an electromotive force in an adjacent and relatively fixed closed conductor which decreases as the speed of the motor increases.

Lamps and Appurtenances:—

Fuse-Block and Socket, F. W. Mount, St. John, Can., 533,913. Filed July 16, 1894.

Carbon for Arc Lamps, E. Thomson, Swampscott, Mass., 533,932. Filed Nov. 26, 1894.
Claim 1:
The method of preventing excess of current at starting in arc lamps employing cored carbons, which consists in removing the core for a short distance from the tip of the carbon.

Electric-Arc Lamp, T. Spencer, Philadelphia, Pa., 534,036. Filed June 6, 1894.
The flexible conductors for conveying current to the movable carbon are replaced by a number of movable elastically supported roller contacts mounted upon arms of the carbon holders and engaging the guides.

Filament for Incandescent Lamps, T. A. Edison, Menlo Park, N. J., 534,206. Filed Jan. 4, 1884.
Claim 2:
The process of making incandescent conductors for electric lamps, which consists in softening a horny animal substance in suitable liquid, forming it into filaments, and carbonizing the same.

Manufacture of Carbon Filaments, T. A. Edison, Llewellyn Park, N. J., 534,207. Filed Dec. 27, 1883.
A carbonizing mold so constructed that the filaments receive the heat equally on all sides and the moulds are adapted to be piled one above the other.

Incandescent Electric Lamp, T. A. Edison, Llewellyn Park, N. J., 534,209. Filed Sept. 17, 1890.
Designed to avoid the platinum leading-in wires. Leading-in wires composed of an outer covering of readily fusible metal or alloy and an inner core or base of metal of relatively high fusing point.

Miscellaneous:—

Electrically-Operated Recording-Instrument for Compasses, C. L. Jaeger, Maywood, N. J., 533,903. Filed Jan. 25, 1894.

Tip for Electric Conductors, A. Metzger, Schenectady, N. Y., 533,910. Filed Nov. 26, 1894.

Series Parallel Controller, E. D. Priest, Schenectady, N. Y. 533,990. Filed Nov. 24, 1894.
Claim 1:—
In a series parallel controller for electric motors, a switch for the motors arranged to connect them in various combinations, in series, multiple series or multiple, and a reciprocating resistance switch adapted to cut in resistance and open the circuit before each of such changes of combination.

Automatic Heat-Regulating Apparatus, W. Waters, Oshkosh, Wis., 533,975. Filed July 20, 1894.
A damper operated by an electromagnet controlled by a thermostat.

Angular Pipe-Section, F. A. Swan, Boston, Mass., 534,021. Filed Aug. 8, 1894.

Electric Railroad Switch, R. A. Baldwin, So. Norwalk, Conn., 534,028. Filed June 27, 1893.
The switch is operated by a rotating cam operated by an electro-magnet.

Apparatus for Manufacturing Caustic Soda, T. Craney, Detroit, Mich., 534,033. Filed May 7, 1894.
The caustic soda when fused has the impurities removed from it by passing current through it.

Air Compressor, J. F. Blake, New Haven, Conn., 534,193. Filed Oct. 18, 1894.
A combination of an air compressor and an electric motor direct connected; the circuit is broken automatically when a given pressure is reached.

Railways and Appliances:—

Electric Locomotive, E. M. Boynton, West Newbury, Mass., 533,861. Filed April 9, 1894.
A construction especially adapted for single rail cars in which the armature is mounted directly on the shaft.

Conduit System for Electric Railways, F. S. Davenport, Jerseyville, Ill., 533,869. Filed Oct. 26, 1894.
An underground conduit having for one of its sides one of the track rails secured to the laterally projecting base of the other side.

Railway Signaling Apparatus, C. L. Fielder, London, Eng., 533,877. Filed June 18, 1894.
A signal rod forming two parts of a locking device normally holding the locking blade in a vertical position.

Distribution System for Electric Railways, W. H. Knight, Schenectady, N. Y., 533,905. Filed Nov. 30, 1894.
A two track railway fed on the three wire system with cross connections so that the motors on one track are at times connected with the neutral and positive main and at the other times between neutral and negative mains.

Electric Automatic Block-System Signal, J. B. Stewart, Haverstraw, N. Y., 533,926. Filed March 8, 1894.
A system in which the signals are operated by an electric motor controlled by polarized relays.

Semaphore for Railway-Signals, D. H. Wilson, Chicago, Ill., 533,983. Filed April 23, 1894.
The semaphore is vibrated by electro-magnetic mechanism while acting as a signal.

Electric Controller, G. F. Card, Covington, Ky., 534,060. Filed May 17, 1894.
For electric cars. The slide contacts are supplemented by snap contacts; the parts are made readily accessible and can be altered or renewed without removing the controller from the car.

Regulating Device for Car-Motors or Other Electrical Apparatus, H. F. Parshall, Schenectady, N. Y., 534,078. Filed Dec. 11, 1891.
A switch for varying the connections to the motor and providing ready means for reversing them; the reversing mechanism is locked so that it cannot be operated except when the controlling switch and resistance device are in a pre-determined position.

Means for Mounting Dynamos on Railway Cars, W. Biddle, Brooklyn, N. Y., 534,092. Filed May 23, 1894.
Specially adapted for generators intended for car lighting.

Supply System for Electric Railways, M. Wheless, Washington, D. C., 534,238. Filed Dec. 3, 1894.
Improvement upon the system of the same inventor patented August 21, 1894, No. 524,775, in which the present invention substitutes an all metal insulated conductor in place of the track rails as a return circuit.

Telegraphs:—

Automatic Telegraphing-Machine, C. E. Yetman, Oak Park, Ill., 534,035. Filed Dec. 2, 1893.
A machine by which the impulses that go to make up a letter of the Morse code are transmitted by depressing a key that controls a transmitting cylinder, a separate cylinder being used for each signal or letter.

Telephones and Apparatus:—

Electrical Exchange System, G. W. Hey and A. E. Parsons, Syracuse, N. Y., 533,893. Filed March 30, 1893.
An automatic exchange system by which subscribers are connected by apparatus moved by step by step motion.

Combined Telephonic and Telegraphic System, C. A. Shea, Boston, Mass., 533,967. Filed July 30, 1892.
The telegraphic impulses in the telephone are neutralized by sending equal induced telegraphic impulses through the telephone in opposite direction to the disturbing impulses.

Telephone Metallic Circuit, C. A. Shea, Boston, Mass., 534,083. Filed July 30, 1892.
A system in which metallic circuit is used for preventing induction but in which at the same time only one wire is employed for talking purposes.

Combined Telephone and Telegraph System, C. A. Shea, Boston, Mass., 534,084. Filed July 30, 1892.
Similar to the above, with the addition of telegraph apparatus the influence of which is neutralized.

Telephone Metallic Circuit, C. A. Shea, Boston, Mass., 534,085. Filed July 30, 1892.
Relates to a telephone circuit of three wires (two of which are line or talking wires, and one of which is a dead wire) arranged in such relation to each other that the single dead wire acts to balance the inductive disturbances in both the live or talking wires.

POLICE TELEPHONE SERVICE.

The Police Department of Buffalo is about to throw out its telephones, from the local telephone company, and put in a service of its own. The police service in Indianapolis also have under consideration the putting in of a special telephone system.

BALTIMORE NOTES.

THE FREDERICK-MCCABE CONSTRUCTION COMPANY has been incorporated with a capital of $50,000. The incorporators are James F. McCabe, Lawrence N. Frederick, Frank H. Sloan, Lawrence P. McCabe, Francis E. Yewell, Frank Slingluff and Wm. G. Stocksdale. The company will do a general constructing business, including electrical work and railway power plants. Mr. Lawrence N. Frederick is president of the company, Mr. Lawrence P. McCabe, manager, and Mr. Frank H. Sloan consulting engineer.

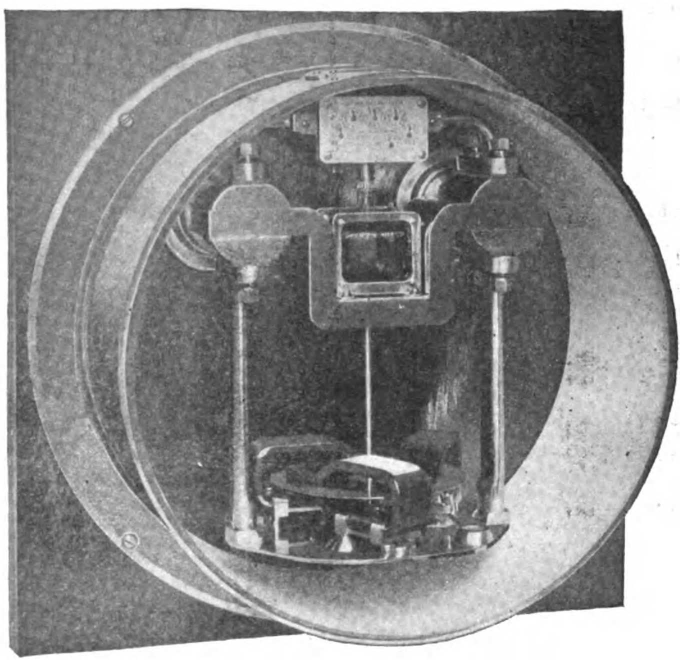
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

STATION OUTPUT THOMSON RECORDING WATT-METERS.

In order to provide a correct instrument to measure the full out-put of a station, and at the same time automatically to record the result, the Meter Department of the General Electric Company has devised a new recording wattmeter known as the form "G." The Form "G" recording meter is a series instrument and takes the whole current through its field. This allows the elimination of all errors which might arise were a high capacity shunt employed. As an instance of the value of this fact "G" meters constructed for 7,500 amperes work accurately and give excellent results even under the comparatively small current of 500 amperes.

The field of the meter consists of a one-half turn made of a solid copper forging of high conductivity, in the form of a wide winged yoke having the wings of sufficient arm to permit of the insertion of the supporting studs. Within the "U" shaped part of this yoke revolves the armature actuating the dial mechanism. The shaft of the armature is as in the other meters prolonged and carries a copper disc which revolves between the jaws of three



FORM G STATION OUTPUT THOMSON RECORDING WATTMETER.

magnets set at the bottom of the meter. The resistance in series with the armature is external to the meter. It is installed at the back of the switchboard and is there out of the way.

The meter is mounted directly on the switchboard, and is supported entirely by the heavy studs which pass through the material of the board and are secured by heavy nuts to the connections behind. The studs thus form the mechanical support and the electrical connections. The cover of the instrument is of bevelled plate glass set in a burnished brass flange and rim fitting snugly against the board, and is provided with a felt packing to exclude dust. All the metal parts of the instrument are brightly polished, and impart to it a very handsome appearance.

As already mentioned these meters have been devised for the measurement and record of the station output. They are intended for connection with each machine or each feeder, or a single large meter may be connected for recording the total output of an entire power or lighting station. They are manufactured in capacities of 2,500, 3,750, 5,000, 6,250 and 7,500 amperes, the first, third and last being considered the standard sizes, and for pressures of 100 and 500 volts. The 100 volt instruments have been designed for use on the three wire system, one meter being placed on each side of the line. The 500 volt meters are for use on railway systems or in stationary plants.

In addition to the meters described above, an arc station wattmeter for measuring the total output of an arc machine has also been devised. In this instrument the principles of the Thomson recording wattmeter have been retained, modifications being introduced to adapt it for use in connection with constant current circuits of high potential. The rheostat used with this arc station meter is a separate piece of apparatus to be installed in front or behind the board. It is designed for use under extremely high pressures, special care being given to the insulation, and is mounted on a marble base. The arc station meters are made in four sizes: 35 lights, 6.8 amperes; 35 lights, 10 amperes; 50 lights, 6.8 amperes; 50 lights, 10 amperes, and measure the output with accuracy.

The meters complete the line of General Electric station recording instruments. For the alternating system, there are the primary meters in capacities ranging up to 600 amperes at 1,000 volts or about 10,000 lamps. For the direct current systems for light, railway and power the form "G" meters, or larger meters of standard form are employed; and for arc systems the arc station meter.

Thus, the station manager now has an absolutely accurate check on the output of his machines or station between any two stated periods. In the morning, his meters show the output in watt hours or horse power hours during the preceding night. Knowing the amount of coal which should have been consumed to accomplish the result recorded, he has a means for readily checking the efficiency of his engines and generators, the operation of the boilers and the efficiency of his firemen.

GENERAL ELECTRIC AT THE CONVENTION.

THE exhibit which will be made by the General Electric Company at the Cleveland Convention will be one of exceptional interest to all engaged in the electric light and power field. The headquarters of the Company will be located at the banquet room of the Hollenden, and will be under the care of the following members of the Company's staff:—From Schenectady: Messrs. S. D. Greene, J. R. Lovejoy, E. W. Rice, Jr., W. L. R. Emmet, F. O. Blackwell, H. C. Wirt. Boston: Messrs. F. M. Kimball, C. D. Haskins, H. A. Harthen. Cincinnati: Mr. W. F. Hays. New York: Mr. T. Beran. Nashville: Mr. H. A. Corson. Chicago: Messrs. B. E. Sunny, Dr. L. Bell, F. N. Boyer. St. Louis: Mr. G. F. Rosenthal. Harrison, N. J.: A. D. Page and W. F. Howell.

The exhibit will be located at the Canal St., station of the Cleveland Illuminating Co. which Company has kindly consented to furnish the necessary facilities for the operation of the machinery. The exhibit will consist first of a working demonstration of the new Monocyclic system of electric light and power distribution recently developed by the General Electric Company. In detail, this will consist of a 230 volt four-pole, 50 kilowatt 575 revolution direct current motor of the latest type which will be run by current taken from the Cleveland Company's circuits and has been installed to operate the plant described below. Belted to this motor will be a Monocyclic eight pole, 60 kilowatt 900 revolution 60 cycle generator, the current from which will operate a 15 kilowatt induction motor making 900 revolutions per minute. Thus in turn will be belted to a four-pole 9 kilowatt 850 revolution direct current dynamo furnishing current to a load of incandescent lamps and Thomson '93 incandescent circuit arc lamps.

The current for the induction motor at 1040 volts primary will be taken from the Monocyclic generator to two of the General Electric recently designed type G 60 cycle transformers of 7½ kilowatts capacity each, and will thence be brought to the motor. In addition, the Monocyclic generator will have as a load a 1000 watt and a 15000 watt type G transformer, with the secondaries connected to a suitable lamp load.

To the 1040 volt primary circuit taken from the generators of the Illuminating Company will be connected a 20 kilowatt 125 cycle transformer. A three wire secondary will run from this and furnish current to 104 volt lamps. In the primary circuit a station primary Thomson recording wattmeter will be connected. The secondaries will be loaded to their capacity with incandescent lamps, Thomson '93 alternating arc focussing lamps, Thomson induction fan motors, etc. The current on the secondaries will be measured by Thomson three wire and two wire meters.

Current from the 1040 volt circuit will also be taken for an exhibit of the General Electric alternating street lighting system consisting of fifty series lamps of 3½ amperes, the sockets of each being provided with the automatic paper cut-out. The working exhibit will be further augmented by a twelve inch hand controlled search light, which will probably be operated on some nearby roof.

The appliance exhibit will consist principally of samples of the latest devices put out by the General Electric Company. These will comprise cut-outs, switches, insulators, etc., showing the excellence of the porcelain of its own manufacture; a full sample board of the new punched clip switches, showing among others, those devised for 500 volt circuits; samples of the new key and keyless sockets.

Altogether the exhibit which the General Electric Company will make will not only be comprehensive, but will prove of more than ordinary interest to all those anxious to keep themselves thoroughly posted on the latest and most approved appliances as well as the most recent developments in electrical practice.

THE FAWCETT AUTOMATIC DYNAMO OILER.

The commutators of arc dynamos require special attention to prevent undue sparking and consequent wear, but it is by no means an easy matter to get just the right quantity of oil on the segments and to distribute it evenly. After prolonged experiments, Mr. L. Fawcett, of Eureka, Cal., has succeeded in devising an automatic commutator oiler which is illustrated in the accompanying engravings. Fig. 1 shows the oiler with the wiper arm in position for work and Fig. 2 presents it with the arm thrown back for inspection.

As will be seen, it consists of an iron frame fastened to the oil pipes of the dynamo bearings. A small belt runs from the dynamo shaft to a pulley on the oiler, which in turn drives a worm

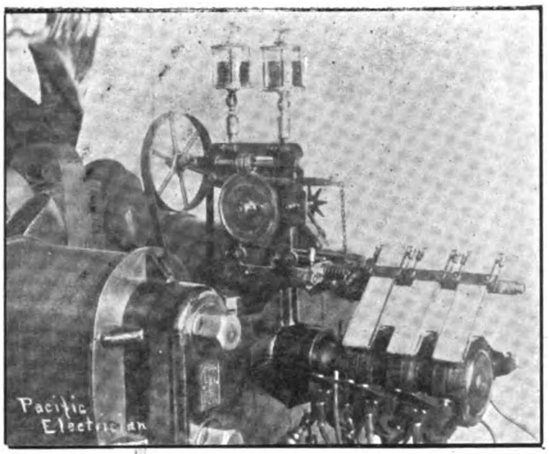


Fig. 1.—Fawcett Automatic Dynamo Oiler.

gear to reduce the motion. The cross shaft of the worm gear carries an eccentric and a cam. The eccentric, in raising, lowers the wiper arm, and the cam moves the pads across the segments, while they are held in contact by a spiral spring on the wiper arm. This spring serves the double purpose of holding the pads down on the segments, and acts as a differential with the cam in moving the pads across.

The pad is an endless belt of canvas stretched across a thin strip of wood, about the width of the copper brushes. Between the canvas and the wood, on the under side of the wiper, is placed a piece of felt, ¼ inch thick, and about 1½ inches square. This felt is saturated with castor oil at the beginning of the run, and is placed in position under the canvas, the tension of which holds it securely. When the pads are lowered in contact with the commutator, the pressure (which is adjusted by the spring mentioned above) is just sufficient to squeeze enough oil through the canvas to properly lubricate the segments. The pads are not held con-

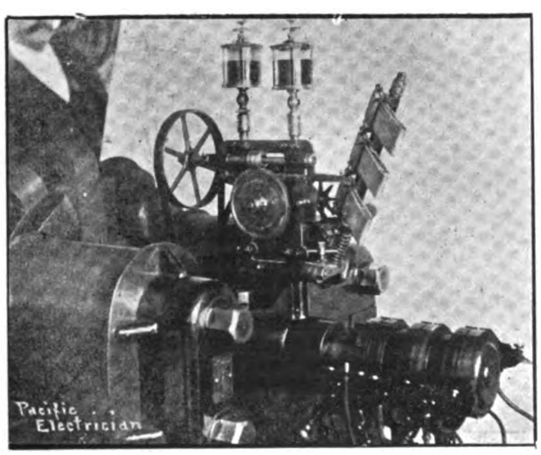


Fig. 2.—Fawcett Automatic Dynamo Oiler.

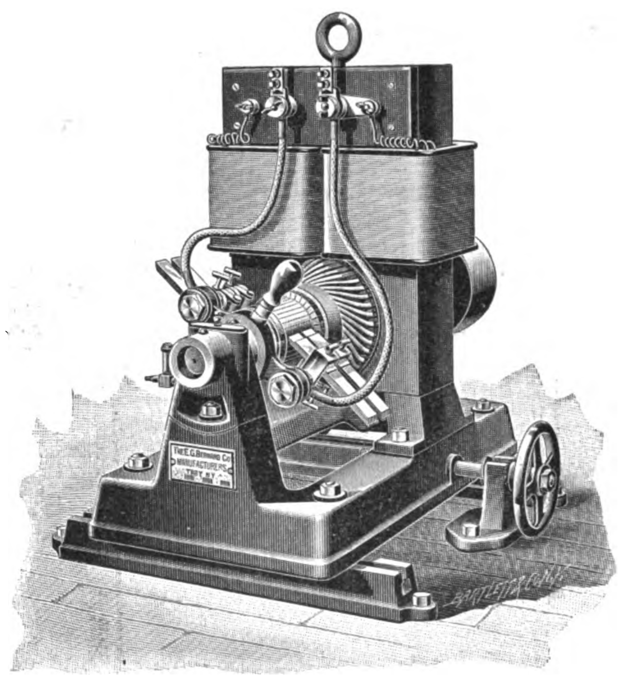
stantly in contact with the segments, but remain only long enough to move across the segments twice. They are then raised by the eccentric on the worm shaft, and held off until the time comes for another wipe, the period for which can be regulated to suit the conditions.

The machine requires no attention whatever, from starting the dynamo to shutting down. When it is necessary to remove the brushes, or clean the commutator, there is only one thumb-screw to loosen, when the wiper arm can be thrown back out of the way, giving ample room for work on either commutator or oiler. The whole time and attention given the oiler does not exceed five minutes per day. We are indebted to the *Pacific Electrician* for the accompanying illustrations.

THE ADAMS DYNAMO AND MOTOR.

The accompanying engraving represents the improved Adams dynamo and motor, which the E. G. Bernard Company of Troy, N. Y., have been building for some time past. While they have not aimed at bringing out any new style or type of machine, they have greatly improved on this standard type in a number of details. One of the principal features, however, is the magnetic field which is made of wrought iron forged in one piece, thus doing away with all joints in the magnetic circuit and decreasing the number of parts, which, from an engineering point of view, is of considerable importance: besides making an extremely simple and compact machine of high efficiency. It is said to have the least number of parts of any machine at present on the market.

The insulation is of mica, throughout. The mechanical details are of the latest, such as self-oiling bearings, self-centering phosphor bronze journal boxes, automatic brush holders and positive belt adjusting rails. The commutator is made of tempered copper insulated with best quality of India mica. The dynamos are compound wound and absolutely automatic, under all conditions of



Adams Dynamo and Motor.

load. All parts of the machines are interchangeable and any parts proving defective in one year, will be replaced free of charge by the manufacturers.

The Bernard Company are just issuing an attractive price list and testimonial sheet, the latter, by the way, is a novelty in testimonials and reads as follows: "We, the undersigned, hereby certify that we have the system of electric lighting and power, as installed by E. G. Bernard, in our factories and buildings, for the period of time set opposite our names, and time thus far has proved all of his assertions and guarantees to be true, the dynamos, etc., having given us perfect satisfaction: and we recommend this system to those desiring similar apparatus. Dated Feb. 15th." Then follows the signatures of over 100 of their customers.

"WIDELY CIRCULATED."

With regard to our recent exclusive article on the Beecher single rail electric system at Waterport, N. Y., the Equipment Construction Co. of Batavia, N. Y., sole contractors for the system there write us under date of Jan. 28: "Please send us 20 copies of The Electrical Engineer of Jan. 16. Your description of our proposed road, in this issue, must have been very widely circulated, as we have had very many inquiries in regard to it." We may state that the issue had our regular circulation, which is always large and constantly growing.

DELEGATES FROM THE ATLANTA EXPOSITION.

H. T. Edgar, secretary and general manager, and Oscar Turner, purchasing agent, of the Georgia Electric Light Company, at Atlanta, Ga. will be at the Cleveland Convention of the National Electric Light Association, as representatives of the Cotton States and International Exposition, to be held at Atlanta, Ga., September 18th to December 31st. Mr. Edgar and Mr. Turner propose to make a trip through the North, taking in the principal cities, where they will confer with the supply houses and electric companies, relative to exhibits at the Exposition. It is calculated to make this Exposition the largest ever held in this country with the exception of the World's Fair. Most of the European and South American countries will be represented. A separate building has been set apart known as Electricity Building, where electrical exhibits will be shown; and the power plant for the purpose of lighting the grounds and buildings and furnishing power will be located in the machinery hall. These gentlemen will have headquarters at the Hollenden where they will meet the electrical people and arrange for exhibits, etc., after which they will take a trip through the East to confer with the heads of the electric companies.

EXHAUST STEAM UTILIZED TO EFFECT ECONOMY.

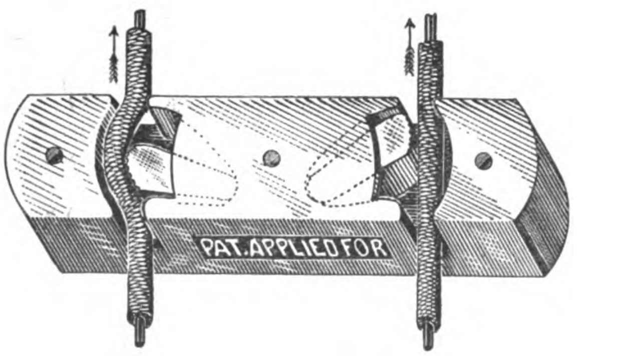
Under this title Messrs. Warren Webster & Co., of Camden, N. J., have issued a most interesting brochure on a subject of constant importance to all steam users. The why and the wherefore of the Warren Webster vacuum feed water heater and purifier are described and the illustrations are not confined to depicting merely the exterior but show the interior construction in a manner that clinches the argument effectively. If any further proof of the efficacy of the Webster apparatus were required it will be found in the list which is given of some hundreds of its users, and of a wealth of letters from representave electric central stations and other concerns in all parts of the United States and Canada, expressive of their appreciation of the saving effected by its use.

BERLIN IRON BRIDGE CO.

The Berlin Iron Bridge Co., of East Berlin, Conn., have finished the new gas house for the Bay State Gas Co., at Boston. The building is 51 ft. wide, 146 ft. long, iron floor, iron roof trusses, and iron purlins covered with slate. The Berlin Co. have also lately completed for the Aqueduct Commissioners, of New York, two iron bridges, one at reservoir M., the other at reservoir D.

THE CREAGER SELF-LOCKING CLEAT.

The accompanying engraving represents a new self-locking cleat which, it is claimed, embodies all the electrical and mechanical requirements of a perfect cleat. Its method of application will be readily understood. By its use it is not necessary to put so many on a ceiling or wall to have the line present a desirable appearance. The arrows show the direction in which the line is being run; all that is necessary is to draw the line as taut as desir-



CREAGER SELF-LOCKING CLEAT.

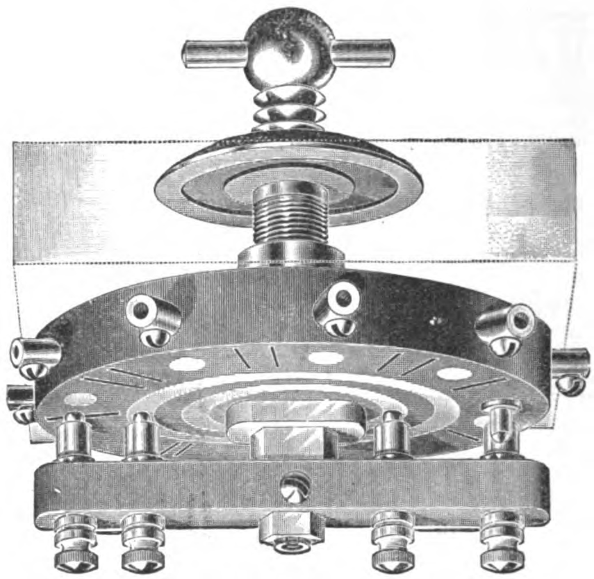
able and release it, and the serrated face of the dog catches it and crowds it into the curved wall, holding it taut and firm. The cleat will take Nos. 16, 14, 12 and 10, and all intermediate sizes of insulated wire, larger cleats holding larger wire.

By the use of this cleat it is claimed one man can do the work of two or three with any other. It does not require one man to pull and one to fasten, but one man can erect all the cleats necessary for an installation, and by reversing the first cleat at the starting point of the line, he can throw up all the wire and simply draw the line up between each cleat, or even two cleats, and let go of it and it remains taut and firm.

This novel device is manufactured by the Creager & Connard Co., of Marseilles, Ill.

NEW "E. E. & S." VOLTMETER SWITCH.

Among the new switchboard appliances manufactured by the Electric Engineering & Supply Co., Syracuse, N. Y. is that of a voltmeter switch, shown in the accompanying cut. From the front of the switchboard nothing is visible but a two and one-half inch dial plate, similar to that of a safe lock, and upon which



NEW "E. E. & S." VOLTMETER SWITCH.

are numbered graduations corresponding to the respective number of circuits. A movable dial, carrying a pointer, is rigidly fastened to a fibre or hard rubber cross bar that sweeps over the surface of the switch base. There are two metallic rings embedded in the base. To these the voltmeter leads are electrically connected. The line contact points are spaced around the outer edge of the base. All wire connection of contact points, and both rings, radiate from the edge of the base, the connector of the inner ring being insulated by a hard rubber tube where it passes through the outer ring.

The cross bar carries on each radius a pair of plungers, connected together in pairs with fuse wire, held under thumb nuts, to protect the voltmeter against possible rise in potential. This combination completes the circuit between the voltmeter and the lines terminating in the diametrically opposite contact points, upon which the outside plungers rest. The standard size of switch is adjustable to boards varying in thickness from three-fourths, to an inch and five-eighths. To eliminate accidental short circuiting of contact points, because of wiping of plungers over the base, two cuts are made in the base between each pair of contacts and in the path of the plungers. The chief merit of this switch is that it is compact and self contained, the only labor necessary in applying it to a switchboard being that of boring an inch hole, screwing the parts together and making the electrical connections at the back of the board.

TEST OF BRUSH ARC MACHINE ON UNDERGROUND CIRCUITS.

An interesting test was recently made at the Manhattan Electric Light Co.'s station in this city, which demonstrated beyond a doubt the entire practicability, of using the higher potentials in underground work.

Three of the regular underground city circuits of the Manhattan Co. were connected in series. The cables of these circuits were the regular lead covered, with rubber insulation which the manufacturer had guaranteed to stand 4,000 volts.

The three circuits combined made a total of 15 miles of wire, of which 10 miles was No. 4 B. & S., 2 miles No. 6 B. & S., and 3 miles No. 6 B. & S. for the connections from lamps to man holes. These cables have been in regular service for some years.

A No. 11 Brush dynamo was used. The rated capacity of this machine was 6,250 volts, at 9.6 amperes. The voltage at the switchboard terminals was a little over 6,500 volts. At this voltage the circuit was opened repeatedly; the cables were not punctured or broken, and did not show any signs of leakage. The circuit was opened at the end, and also near the centre. The discharge of cable and dynamo, when circuit was broken, as measured by spark gap test, was 6,000 volts, or 500 volts less than the E. M. F. of the circuit.

A test was also made as to the length of arc the machine would draw. With a potential of 6,500 volts the arc was less than one foot long. As we are accustomed to hear of four foot arcs drawn from 3,000 volt dynamos, the above results are surprising to say the least.

THE HANDLING OF COAL AND ASHES AT THE 3rd DISTRICT STATION OF THE EDISON ELECTRIC ILLUMINATING CO., BROOKLYN, N. Y.

The problem of handling coal and ashes is one of great interest to engineers designing or in charge of power plants. It is also a problem that admits of solution in such a manner that a great saving may be made in the operating expenses.

In electric lighting and power stations it is required to convey the coal from the receiving point to the furnaces, remove the ashes to some receptacle from which they can be easily taken away, and to accomplish this at the lowest possible cost. In many cases this is not a simple engineering problem, but is so affected by the environment as to make it complex and difficult.

The C. W. Hunt Company, 45 Broadway, New York City, has been prominently identified with the development of coal handling machinery, and installed the apparatus for that purpose in use at the Third District Station of the Brooklyn Electric Illuminating Company, Brooklyn, N. Y.

This station is situated at some distance from the coal wharves and the coal is delivered by wagons. It was necessary to take the coal from the wagons, carry it to the furnaces and also to remove and dispose of the ashes. The arrangement of the machinery installed for this purpose is shown in the accompanying engraving.

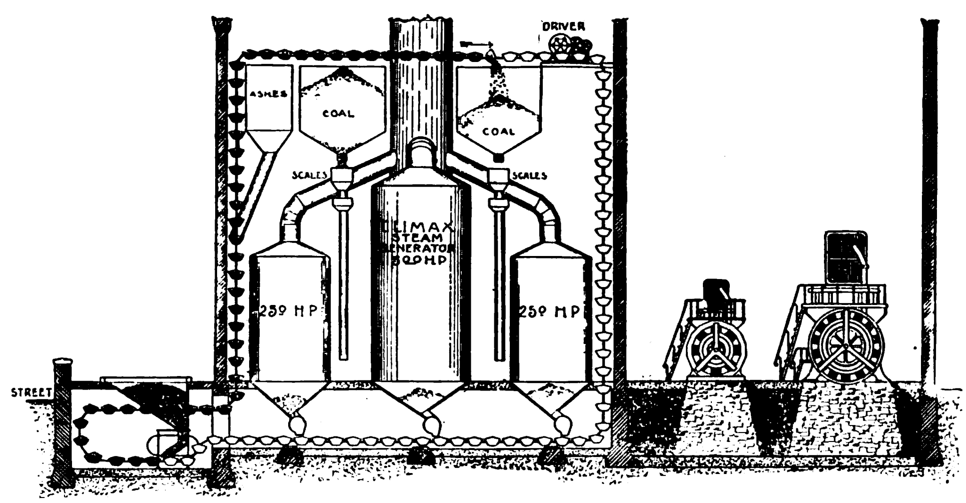
The coal is carried from the hopper underneath the sidewalk to the coal tanks above the boilers by a conveyor which upon its return passes underneath the ash pit of the furnaces and carries the ashes to a bin from which they can be drawn at will for removal. The conveyor consists of a series of gravity buckets pivoted in a double chain, and the whole system is carried on self-lubricating wheels. The buckets are so pivoted in the double chain that the force of gravity keeps them always in an upright position whether full or empty and no matter how tortuous the track over which they are drawn.

The conveyor possesses several features that are peculiarly desirable for this work. The material is carried to its destination by a single conveyor in a horizontal, vertical or angular direction, all of which were required in this station. The change in the direction of the conveyor is made by running around curves instead of over sprocket wheels, and the whole machine is noiseless in its operation. The chain is driven by pawls instead of by sprocket wheels, avoiding entirely the destructive wear heretofore inherent in conveyors, especially as the material does not come in contact with any working part of the conveyor to cause wear. The conveyor is moved slowly, the capacity being obtained by the size of the buckets and not by the speed of the chain.

In this station the necessity for a special method of filling the buckets under the sidewalk will be apparent when it is considered that the buckets swing freely on pivots, and might oscillate to a harmful extent or might be loaded on one side and remain at an angle during the trip. The loading is accomplished by a continuous filler and so perfectly that it would not occur to an observer that there was any liability of swinging or uneven loading.

The filler guides the coal into the buckets, filling each one as it passes.

The power for driving the conveyor is located at the top line, and is furnished by a ten horse-power electric motor. The operating switches are placed below on the boiler room floor for convenience in starting and stopping the machinery. At this station when receiving coal at its full capacity, the power required to operate the conveyor is 4½ horse-power, measured at the switch.



HANDLING OF COAL AND ASHES, BROOKLYN EDISON STATION.

The coal is drawn from the storage bins above the boilers into weighing hoppers from which it is spouted to the floor of the boiler room at such distance as to be easily shovelled directly into the furnaces.

Handling ashes either wet or dry has heretofore been considered one of the most difficult objects to accomplish, and one of the most destructive to machinery, but in this station is accomplished so completely by the use of a special filler, one of which is placed under each boiler and is always ready for work, that it is as easy to handle the ashes as the coal. C. W. Hunt & Co. issue an interesting pamphlet on this subject.

PERCENTAGE PREMIUMS FOR THE MEN.

The electric railway company at Glens Falls, N. Y., has introduced a novel method of paying some of its employees for the coming year in the shape of a premium consisting of a percentage of the returns made by each conductor, and, in the case of the motorman, a share of the savings effected in car repairs.

NEW YORK NOTES.

THE STREET CAR ACCOUNTANTS of New York State have been in conference with the State Railroad Commission to provide for a more comprehensive and uniform system of reporting the operations of their respective companies.

THE GUEST-BATES MARINE LIFE SAVING APPLIANCE COMPANY is the name of a new corporation with office at 84 Hudson street, Hoboken. It will manufacture life saving apparatus, and will pay especial attention to electric lighting for such appliances, thereby increasing the efficiency at night. The incorporators are James A. Guest, of Washington, D. C.; James H. Bates, Charles J. Bates, of Rutherford, N. J., and L. C. Chew and George N. Newcombe of Hoboken. The capital stock is fixed at $100,000.

ROCHESTER, N. Y.—The Northern Alleghany Telephone Company have arranged to extend their line from Fillmore to Short Tract as soon as spring opens.

THE OKONITE COMPANY, Limited, will be represented at the Electric Light Convention by Capt. Willard L. Candee and George T. Manson, without whom no gathering of the electrical fraternity would seem quite complete.

W. R. FLEMING & Co. report business as unusually satisfactory. The number of Ide and Ideal engines installed in the past year is fully fifty per cent. greater than the year of '93 and one hundred per cent. greater than '92. This is an unusually good showing considering the almost universal depression of business generally.

THE ABENDROTH & ROOT MANUFACTURING COMPANY, 28 Cliff street, New York City, are the sole makers of the Root improved water-tube boiler so generally employed now-a-days in electric lighting and street railway power stations. They have branch offices in the Perin Building, Cincinnati, O., Monadnock Building, Chicago, Ill., Security Building, St. Louis, Mo., and at No. 8 Oliver street, Boston, Mass. The company will be represented at the Convention by Mr. P. M. McLaren, and those of the electrical fraternity desirous of becoming better acquainted with the merit of the Root boiler for this especial class of work, will find him ready at all times to aid them in the matter.

BOILER EXPLOSION AT WASHINGTON, ILL.

A bad boiler explosion occurred on Feb. 4, at the Washington, Ill., electric light plant. Five men were injured, and the plant was knocked into a cocked hat and the adjoining lots.

NEW GENERAL ELECTRIC LIGHTING APPLIANCES.

THE General Electric Company has within the past few weeks placed on the market a new cut-out and a new socket, embodying in both improvements of an important nature. The former, a double pole single or double cross-over branch plug cut-out, Fig. 1, is so constructed as to facilitate its attachment, to the wires already placed, while holding the wires well apart where they cross. It is a very compact device, of the well-known plug fuse type, the fuse being held in a brass covered screw plug, which is inserted in the female screw shell secured to the porcelain. Replacement of the fuse entails no further labor than is involved in the unscrewing of the fuseless plug and the insertion of a perfect one, and it is this feature which renders the plug-cut-out so valuable especially in residences and places where fuses have to be cared for by unskilled persons.

The lamp socket, Fig. 2 is the outcome of a well-founded knowledge of the conditions which should be fulfilled by a first class socket, and while embodying the best features of all preceding sockets, embodies also improvements which ensure the best results in practice. It is smaller than the well-known Edison socket, and in construction is extremely simple. The entire base is formed

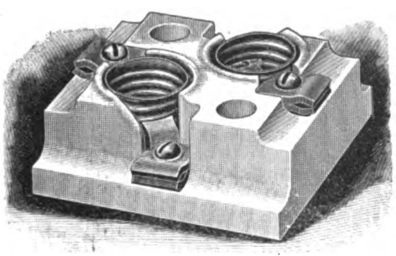


FIG. 1.

FIG. 2.

of one porcelain piece of conical shape, and so ridged perpendicularly that the possibility, of short circuit between the working parts is practically nil. The key may be turned in either direction. The central connection for the lamp base is a well tempered contact spring against which the lamp is screwed and a good contact made, while the spring serves to prevent the lamp from wearing loose. The wires are connected as directly as possible, needless joints being avoided. The insulating collar between the screw shell and outside shell is firmly locked in place and extends one-sixteenth of an inch beyond the shell.

Every precaution has been taken to produce an appliance the usefulness of which cannot be impaired by the ordinary carelessness of wiremen or fixture fitters. The porcelain used in these appliances is manufactured by the General Electric Company in its own porcelain works at Schenectady which were especially constructed for the production of porcelain possessing the high insulating qualities for which the stringent conditions of the government specifications and insurance rules call.

A PITHY AND BREEZY CIRCULAR FROM THE STANDARD PAINT CO.

The Standard Paint Co. has issued from its New York headquarters, No. 2 Liberty street, a very artistic circular with regard to its celebrated "P & B" insulating materials, insulating tape, insulating papers, armature and field coil varnish, ruberoid roofing, etc. A number of strong testimonials are included, showing high appreciation after long years of use, but perhaps the best part of the circular is its introduction, which is so neat and vigorous an argument to the consumer, that we cannot refrain from quoting it:—

The P. & B Products have been before the public for many years. The manufacturers take just pride in the reputation their goods have attained with electricians and manufacturers of electrical goods, at home and abroad. During this period many compounds have been put on the market, which were claimed to be as good as P. & B., with nothing to prove their bold assertions except their own claims. During the past two years more so-called insulating compounds than ever have confused the electrical fraternity. Many of them advertise that their materials have no offensive odor. Electricians everywhere know that the offensive odor of P & B., which disappears almost immediately after application, means lasting and penetrating qualities and thorough insulation. Other unscrupulous manufacturers advertise their materials under trade marks so similar to the well-known letters "P. & B." as to be misleading. Our well-known trade mark with the "Rooster" and letters "P. & B." is on all of our packages. See that they are on all of yours. If your local dealer does not handle the P. & B. products, write us direct. We are keeping abreast with the times. The P. & B. compounds to-day are used more than ever, and we append herewith a few testimonials selected from hundreds received from all parts of the country. We believe in both the old and the new. Parties have claimed that letters we publish are so ancient that they are of no use. We therefore give letters written us years ago, by people who had at that time already used our material for years, who now write again renewing their testimony. These letters are all genuine. We invite anyone to write direct to those whose names are signed to letters we publish. P. & B. compounds are highly recommended by the boards of fire underwriters in the leading American cities, for coating mouldings to be placed in damp places, making cut-out boxes waterproof and practically fire-proof. P. & B. is water, acid and alkali-proof. It is the best made for circuit and switch-boards, lamp hoods, dynamo and motor bases, and all general insulating and preservative purposes. The P. & B. compound is largely used for coating lead covered and other cables for underground use, and for insulating overhead wire, and re-insulating defective wire. P. & B. armature varnish and insulating papers are so well known everywhere, we feel it will not be necessary in this to dwell on their merits. P. & B. products have become so well and favorably known, that they are now used and asked for in foreign countries extensively. We respectively invite correspondence from everyone, in any way interested, and will gladly furnish samples of any of our products with full information, on application.

IMPORTANT ELECTRIC LIGHT DEAL AT BROCKTON, MASS.

A syndicate of local capitalists, which controls the Brockton street railway, has secured a majority of the stock of the Edison Electric Illuminating Company of that city. At a meeting of the directors a number of the board were retired and their places taken by the new owners. A. A. Glazier is president. The plant is to be thoroughly renovated under the direction of Stone & Webster.

PROPOSED INCREASE OF PHILADELPHIA TRACTION STOCK.

A meeting of the stockholders of the Philadelphia Traction Company is expected about the middle of March to vote upon a proposed issue of $5,000,000 more stock. The company is now said to have a floating debt of from $5,000,000 to $6,000,000, which has been paid out in the equipment of the system with electricity, and the money that will be raised on the stock will be used in paving this floating debt.

It is understood that the stockholders have the right to subscribe for the new stock at par, receiving in proportion one share of new stock to three that they now hold.

WESTERN NOTES.

THE INDIANA ELECTRIC LIGHT Companies have taken action in forming a state association for mutual and joint protection.

NORWALK, O.—The Bell Telephone Co. have finally been forced to reduce their prices here, as the Harrison Co. have been taking all their business.

SOUTH PEORIA, ILL.—The Council of the village of South Peoria has given a franchise to the Peoria & Pekin Electric Railroad. The road will connect the two cities running on the Peoria side of the river and crossing at Pekin probably on a bridge of their own. It will connect with the Fort Clark road. Passengers will be transferred at the city limits and can thus go to any part of the city without extra charge.

THE ELECTRIC APPLIANCE COMPANY will be pleased to furnish copies of their new catalogue with special trade discounts on application. In preparing this catalogue, the Electric Appliance Company have made it consist wholly of electric railway supplies, not considering it necessary to pad it out with material which comes properly under the head of electric light supplies. This line of electric railway material will also be included in their new issue of general catalogues, which, it is promised, will be a most complete catalogue of general supplies.

OTTAWA, ILL.—The Electric Street Railway here has been sold to a home syndicate by the General Electric Company for $40,000 in bonds, a condition in the contract requiring the local syndicate to invest $20,000 additional in improvements. The road cost originally $115,000 and was the first electric road operated in Illinois. For some time past the property has been allowed to become badly crippled through lack of repairs, and for a year hardly paid the operating expenses. The new management will take possession March 1st, and will immediately place the property on a paying basis by making the necessary improvements and repairs.

NEW ENGLAND NOTES.

THE GENERAL ELECTRIC Co. will, it is stated, resume the manufacture of incandescent lamps at Lynn, with about 150 hands. There are now 2,200 names on the Lynn pay roll.

UNITED ELECTRIC LIGHT & POWER Co.—The new power station for the United Electric Light & Power Co., of New York, N. Y., is now being put up by the Berlin Iron Bridge Co., of East Berlin, Conn. This will be one of the largest and most complete plants in the United States. The engine and dynamo room is 100 ft. square, and the boiler room is 60 ft. by 100 ft. The engine and dynamo room is to be covered with the Berlin patent anti-condensation corrugated iron. The coal pockets over the boiler room will have a capacity of 3,000 tons of coal.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
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THE LEONARD ELECTRICALLY HEATED APPARATUS.

BY

H. Ward Leonard

As the majority of the sellers and users of electric energy look upon the production of heat by electric energy as uncommercial I shall, before describing the underlying principles of my invention endeavor to point out the field for the sale of electric heat as it appears to me.

Every central station is suffering from the fluctuating character of its load. In the case of a comprehensive central station the ratio between the maximum number of incandescent lamps in operation at any one time and the total number of lamps connected to the system is only about 30 per cent. And again, the ratio between the average number of lamps in use during the 24 hours and the maximum load is only about 40 per cent. so that the average load continuously operated is for incandescent lamps only 12 per cent. of the connected load. This means that the fluctuations in the load due to exceptionally dark days, etc., are very great, and we must for this kind of a load have a plant 4 times as large as we would have to have if we could produce a constant load for 24 hours per day and 365 days per year.

Electric motors represent a somewhat better load, for, while the maximum load is again about 30 per cent. of the connected load, this maximum load is not so freaky and erratic, not being dependent upon the weather, and the average load is about 45 per cent. of the maximum.

If we had a load represented by current sold to supply soldering irons, flat irons, glue pots, metal melting pots, and a lot of such tools as are used in various manufactur-

Figs. 1 and 2.—The Leonard Electrically Heated Soldering Iron.

ing establishments practically continuously for 10 hours per day the ratio of the maximum supplied load to the connected load would be probably not less than 70 per cent. and the average load would be at least 50 per cent. of the maximum and 35 per cent. of the connected load. Such a load would be practically independent of the season of the year and the condition of the weather. It would also be free from the objection attributable to most motor loads, namely, causing variations in the candle-power of the lamps on the same circuit. It is a load which can be sup-

Figs. 3, 4 and 5.—Leonard Electrically Heated Apparatus.

plied equally well by a continuous or alternating current and of any voltage from 50 volts to 500 volts, and does not require the refinement of exact E. M. F. demanded by incandescent lamps.

Evidently this is a good kind of load to secure. Why is it that so little of this kind of load exists? With the electrically heated apparatus heretofore available these were some of the reasons :

1. The electrically heated tools for which the greatest demand exists, such as soldering irons and similar tools requiring a working temperature of from 500° F. to 1200° F., could not be made to work commercially.

2. Such electrically heated devices as have been on the market, such as certain cooking utensils and air heaters, were too expensive in first cost to be much used.

3. The amount of current required by the heaters was so great that they could not be attached to existing lamp sockets and hence new circuits, switches, etc., had to be installed wherever the articles were to be used, which greatly interfered with the introduction and use of the electrically heated devices.

4. The amount of energy required to operate them was so great that only those prepared to pay for a luxury could afford to use them.

I believe that all of the above objections have been overcome in the electrically heated apparatus made under my inventions. In this new apparatus, the resistance

material in which the heat is developed has an extremely high fusing point. It is surrounded by a thin coating of an almost infusible insulating material and then the thinly insulated resistance is embedded in and closely surrounded by a closely applied mass of metal. The heated resistance is hermetically sealed from the air and is surrounded by a medium with which it cannot combine chemically. The result is that the apparatus can readily be operated at a red heat without destructive effects.

In making electrically heated apparatus prior workers in this field have taken an existing device practically without alteration and heated it by electric energy instead of by putting it on a stove or in contact with some such source of heat. Thus such electric flat irons, soldering irons, glue pots, etc., as have been designed heretofore have looked just like the similar ordinary devices except that they had a flexible cord leading to them.

The ordinary soldering iron, flat iron and similar tools are heated by being placed in contact with a source of heat from which they are then removed and are used until the temperature has fallen below the proper working temperature, when they are again heated up by placing them in contact with the source of heat. It will be evident when stated, that in all tools to be so used the most important feature is that they shall have a maximum storage capacity for heat, so that they will remain hot enough to work with, for the longest time possible. When the source of heat is in the tool itself this storage capacity for heat is not only unnecessary but extremely detrimental; for a very large amount of energy or a considerable length of time will be necessary to bring them up to working heat; and then, because of the large volume and surface the larger portion of the heat developed is lost by radiation from idle surfaces, and only a small proportion of the whole heat developed is utilized at the working surface.

The underlying principle of my electrically heated tools is to make the working surface as small as may be; to have the least possible mass of material with the least possible idle surface and to have the material composing the tool of the lowest specific heat commercially practicable. The result of following these ideas will be evident by inspection of Figs. 1 and 2, which show a 50 watt soldering iron. This soldering iron is wound for 50, 110, 220 or 500 volts, and is suitable for work such as soldering sheet metal $\frac{1}{32}''$ thick or any lighter work; it requires but 50 watts and can be attached to any existing incandescent lamp socket. It will melt solder in a few seconds after the current is first turned on. Soldering irons as have been heretofore made have required, while they lasted, from 400 watts upward and naturally they heated up quite slowly on account of the large storage capacity of the mass of metal.

Electric melting pots for melting any metals and alloys whose melting point is, say, 1,200° F. or under, will be another new and useful electrically heated tool, soon to be brought out.

Any one of the tools mentioned and also such devices as chafing dishes, coffee pots, curling irons, disc heaters, etc., as illustrated in Figs 3, 4 and 5, are operated by 150 watts or less, so that attachment can be made to any existing lamp socket. A separable handle on each device constitutes a convenient form of switch at the device itself.

Unit.	*Equivalent Value in Other Units*
1 K. W. Hour	1,000 Watt hours. 1.34 horse power hours. 2,656,400 ft. lbs. 3,600,000 joules. 3,440 heat units. 366,848 kilogram metres. 229 lbs. coal oxidized with perfect efficiency 3 lbs. water evaporated at 212° F 22.9 lbs. of water raised from 62° to 212° F. 8 cents at usual rates for electric heating.
1 H. P. Hour —	.746 K. W hours. 1,980,000 ft. lbs. 2,580 heat units. 273,740 k. g. m. .172 lbs. coal oxidized with perfect efficiency. 2.25 lbs. water evaporated at 212° F. 17.2 lbs. water raised from 62° F to 212° F. 6 cents at usual rates for electric heating.
1 K. W. —	1,000 Watts. 1.34 H. P. 2,656,400 ft. lbs. per hour 4,424 ft. lbs per minute. 73.73 ft. lbs per second. 3,440 heat units per hour 573 heat units per minute. 9.55 heat units per second .229 lbs coal oxidized per hour 3 lbs. water evaporated per hour at 212° F
1 H. P. —	746 Watts. .746 K. W 33,000 ft. lbs. per minute. 550 ft. lbs per second. 2,580 heat units per hour. 43 heat units per minute. 71 heat units per second. 172 lbs. coal oxidized per hour. 2.25 lbs water evaporated per hour at 212° F.
1 Joule —	1 Watt second. 00000278 K. W hour. 102 k. g. m. .00094 heat units. .73 ft. lbs.
1 Ft. Lb. —	1.36 joules. 1383 k. g. m 000000377 K. W. hours. .000291 heat units. .0000005 H. P hour.
1 Watt —	1 joule per second 00134 H. P .001 K. W 3 44 heat units per hour 73 ft. lbs. per second. 003 lbs of water evaporated per hour. 44.24 ft lbs. per minute.
1 Watt per Sq. in. —	3.26 thermal units per sq. ft. per minute. 120° F above surrounding air (Japanned cast iron surface.) 66° C above surrounding air (Japanned cast iron surface.)
1 Heat Unit —	1,048 Watt seconds. 772 ft. lbs. .252 caloric (Kg.-d.) 108 kilogram metres. .000291 K. W. hour. .000388 H. P. hour. .0000667 lbs. coal oxidized. .00087 lbs. water evaporated at 212°F.
1 Heat Unit per Sq. Ft. per Min. —	.121 Watts per square inch. .0174 K. W. .0232 H. P.
1 Kilogram Metre —	7.23 ft. lbs. .00000366 H. P. hour. .00000272 K. W hour. .0092 heat units.
1 Lb. Bituminous Coal Oxidized with perfect efficiency —	15,000 heat units. .98 lbs. Anth'cite coal oxidized. 2.1 lbs. dry wood oxidized. 15 cu. ft. illuminating gas. 4.37 K. W hours (theoretical value.) 5.81 H. P hours (theoretical value.) 11,590,000 ft. lbs. (theoretical value.) 13.1 lbs. of water evaporated at 212° F.
1 Lb. Water Evaporated 212° F. —	.33 K. W. hour. .44 H. P. hour. 1,148 heat units. 124,200 k. g. m. 1,219,000 joules. 887,800 ft. lbs. .076 lbs of coal oxidized.

USEFUL EQUIVALENTS FOR ELECTRIC HEATING PROBLEMS.—BY H. WARD LEONARD.

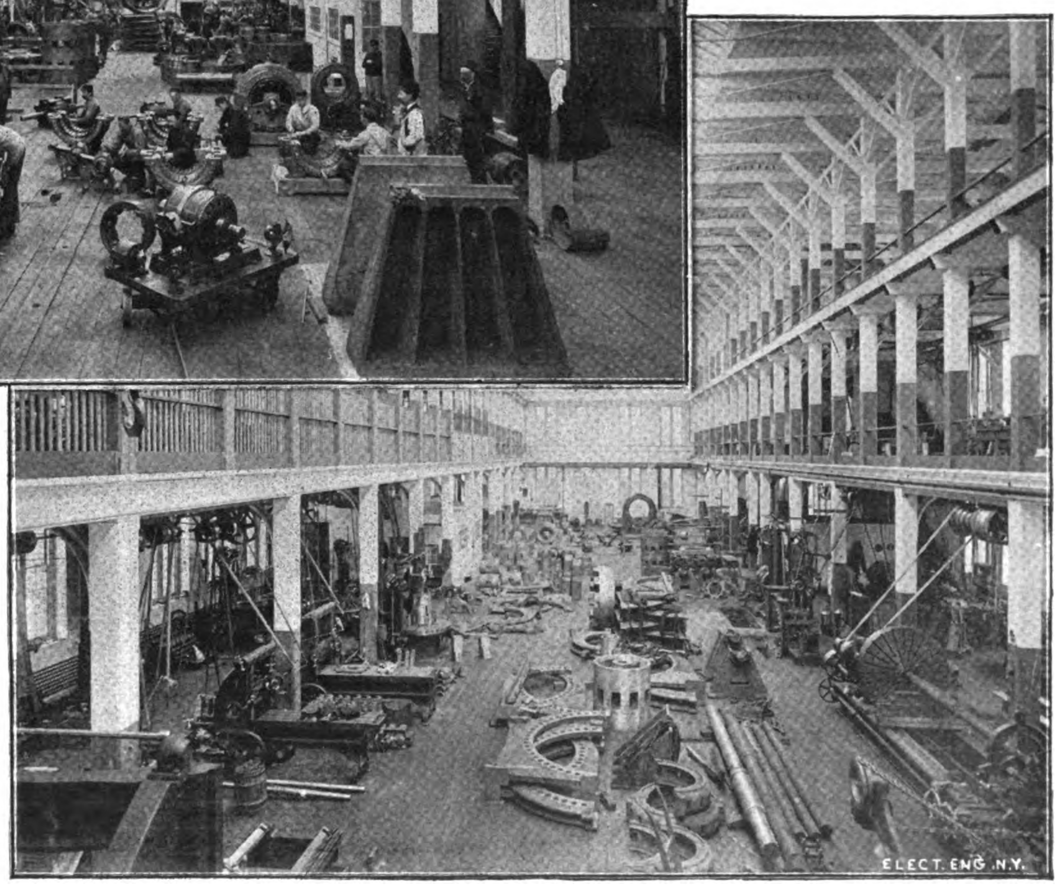
ELECTROSCOPES IN LECTURE.

Dr. Oliver J. Lodge writing to *Nature*, says:—"I suppose teachers still use gold leaf electroscopes for their junior lectures; certainly I have found nothing else so dead beat, or so readily understood; and by projecting with a lens a shadow of the leaves on a square-foot translucent screen, the movements are perfectly visible to a large audience by daylight. But the one objection to the instrument, when used for explaining the fundamental facts, say, of induction, is that it indicates similarly positive and negative potentials. Yesterday, however, my assistant, Mr. E. E. Robinson, ingeniously stood the metal-case instrument on a cake of paraffin wax, and electrified its outside negatively. By this process the zero of deflection is changed; the leaves stand apart for zero potential, diverge more for positive, and collapse for negative. A zero shadow-pointer and rough scale may be readily used; and I propose now to mount a projection electroscope in a suitable slightly-charged Leyden jar, whose outer coat can then be treated as the usual earthed terminal of the instrument, whose case is connected to, or formed by, the inner coat of the jar. The insulated or variable terminal is conveniently arranged as an insulated sphere or other shaped body on the lecture table, not far from the small screen, attached by a long enough thin wire to the leaves—of which it is perhaps best to have one movable."

THE STANLEY ELECTRIC MANUFACTURING CO. AND ITS TWO-PHASE WORK.

I.

THE Berkshire Hills in Massachusetts, so noted for their picturesque beauty, have also a special interest for the electrical engineer for it was here in the pretty little town of Great Barrington, that the first alternating current transformer plant in this country was put in commercial operation due to the enterprise and ingenuity of that young enthusiast, Mr. Wm. Stanley, Jr. After the lapse of ten years we find at but a short distance from the pioneer alternating station, at Pittsfield, Mass., large new works devoted to the manufacture of apparatus scarcely dreamt of when the current was first turned on the slender conductors at Great Barrington.



Views of The New Stanley Works, From North and South Ends.

II.

The main cause which led to the erection of the new shops of the Stanley Company is but a repetition of the story, so often met with in American industrial annals, of small and modest beginnings, which, after but a short lapse of time, expand far beyond the original scope of their promoters. The old shop in which the Stanley Company began its work occupied but a single room on the ground floor of a building, but as the work proceeded and the demand for two-phase motors and alternators became greater and greater, it was evident that larger and better equipped quarters would have to be provided. At the present time the original shop is devoted exclusively to the manufacture of transformers. The new shop was therefore laid out on the most modern lines and presents an example of the highest type of American machine shop construction. The building is 200 feet long by 80 feet wide, and constitutes a central machine and erecting floor, around which rise three galleries, 15 feet wide, affording space for the lighter machinery. The distribution of light is an ideal one, an abundance being furnished by the windows at the side and by the glass monitor roof. Perhaps the best proof of this even distribution of light is to be found by a glance at the engravings on this page which give two views of the shop, taken from either end.

As will be noted, the main floor of the new shop is devoted to the assembling of the machines and here also the heavy machine tools are placed. The engraving on page 188 shows the large planer built by the Gleason Tool Company, which is able to take in work 6 feet wide by 16 feet long, and which works simultaneously with two horizontal and one vertical tool head. Close beside it is

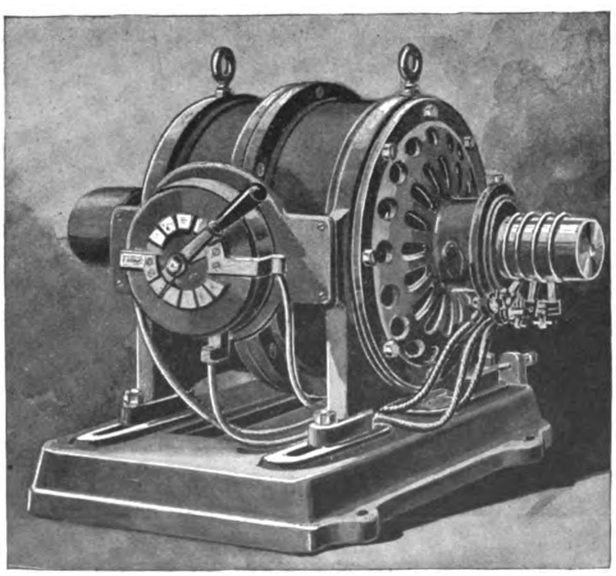
the great boring mill, shown on page 187, built by the Niles Tool Works, which has a swing of 17 feet diameter, with a five foot rise. This machine is separately driven by a two-phase alternating motor of the Stanley Co.'s type, placed between the main ways and which can be shut down when the machine is not in operation. A few steps further brings us to a big lathe, having a 72-inch swing, 29 feet long, also built by the Gleason Company, while another lathe, having a 36 inch swing, 27 feet long, built by the Fitchburg Machine Works, of Fitchburg, Mass., enables work of the largest character to be handled with ease. The Fitchburg Machine Works has also furnished the new Stanley factory with six engine lathes ranging from 14 to 32 inch swing, two 72 inch radial drills, three 30 inch and one 25 inch upright drill and two planers, 30 inches by 8 feet, and 24 inches by 6 feet.

The north end of the main floor is devoted exclusively to the assembling and testing of the generators and motors. For this purpose a separate Ball & Wood engine of 250 horse power is employed, together with a small Armington & Sims engine for driving a testing generator. Test loads are thrown into Carpenter enamel rheostats, which are non-inductive in their nature, and hence, while answering the same purpose as the incandescent lamps heretofore employed, have the advantage that their life is far greater and that they can be very much overloaded; thus, a rheostat designed for 100 volts will carry 150 volts for a short time, if necessary. When high voltage generators are to be tested for insulation, they are, for the sake of precaution, lifted off the floor and suspended by the travelling crane and insulated from the crane.

The entire north end of the floor, devoted to testing and assembling, consists of a solid base of piers filled in with concrete over a space 50 x 18 feet. There are also in place here a pair of balancing ways, consisting of heavy steel rails mounted on stone foundations and filled in with asphalt. As we passed through the shops recently, the large 240 K. W. 2-phase alternator, illustrated on page 187, was undergoing test.

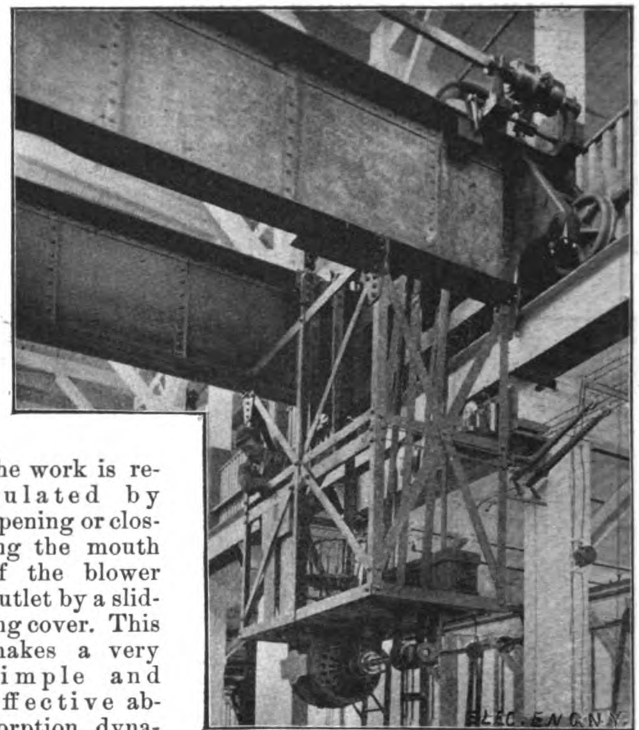
III.

Mounting to the first gallery above the main floor, we find at the northeast end the department devoted to the



THE S. K. C. TWO-PHASE ALTERNATING MOTOR.

testing of small motors and exciters, shown on page 188. This department is equipped for testing up to 12,000 volts, since the machinery intended for 5,000 volts is tested at double that voltage. For absorbing the power of the motors to be tested, Sturtevant blowers are employed and



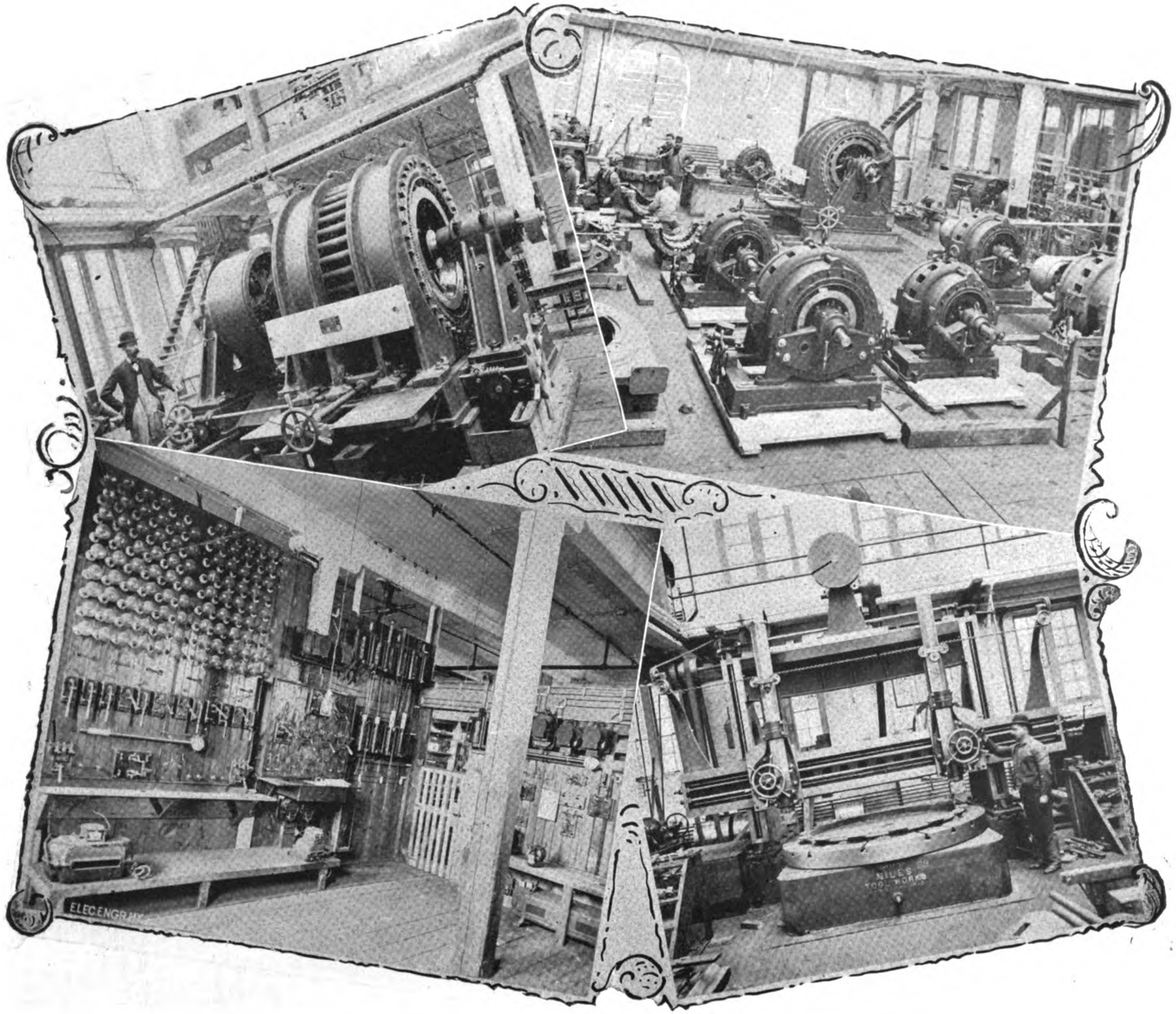
S. K. C. MOTOR DRIVING SHOP CRANE.

the work is regulated by opening or closing the mouth of the blower outlet by a sliding cover. This makes a very simple and effective absorption dynamometer. We also noticed here an ingenious high voltage circuit-breaker, which is so arranged that, as the switches open, fibre tongues move out and cover the contacts so as to break the arc.

At the northwest end of the gallery is the punching department, where the armature and inductor plates of the alternating machines are punched out of sheet iron, the punching department being equipped with the latest Ferracute, Bliss, and Eaton punch presses. Beyond this is the tool room, equipped with Pratt & Whitney shapers and planers, Garvin, Brainerd, and Becker milling machines, shown on page 188, and around on the east side are the Pratt & Whitney and Jones & Lamson bolt and screw cutting machines and other special machinery for small work by Sloane & Chase. To these we may add the grinders from the Diamond Machine Co., Springfield Emery Wheel Co, Landis Bros., Gisholt Machine Co., and Blake & Johnson. The machines in this department are driven by a two-phase motor, as shown on page 188. The second gallery is devoted to the carpenter shop, store room for appliances, such as rheostats, exciters, starting boxes, etc., and as a stock room of motors from 1 to 40 horse power. At the southwest end of this gallery is the winding department for the motor and generator coils.

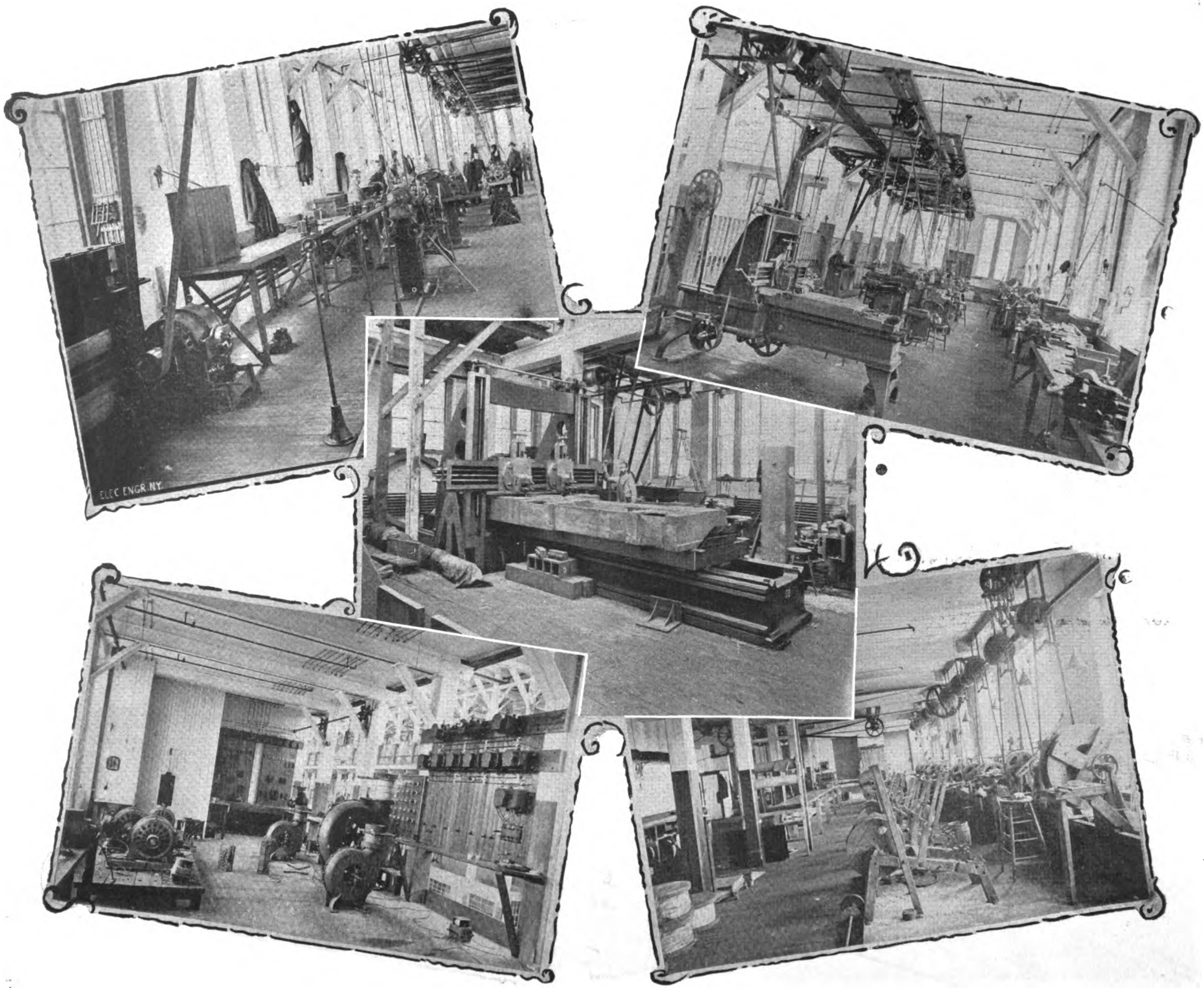
III.

The Stanley Company are thorough believers in the economy of individualizing the power machinery of factories, and as a result have equipped their own new works on this modern plan. Throughout the main floor and galleries are lines of shafting driven by half a dozen individual motors, while, as shown in the instance of the large boring mill, individual motors are applied to heavy tools. The current for driving these motors is obtained from the circuits of the Pittsfield Electric Company, situated close beside the Stanley shops, the power being contracted for at a certain rate per horse power per annum. Coupled with the fact that the central station operates continuously, day and night, and with the further fact that the Stanley works have been similarly operated ever since their completion, in order to keep up with the work on hand, this method has proven eminently satisfactory and economical. At the station of the Pittsfield



A 240 K. W. S. K. C. Generator Ready for Test. The Erecting Department, Main Floor.
The Transformer Testing Room. The 17 Foot Boring Mill.

Views in The Works of The Stanley Electric Manufacturing Co., Pittsfield, Mass.



Stanley Motor Driving Screw Machines. The 16-Foot Planer. The Tool-Room.

The Motor Testing Department. The Transformer Winding Department.

Views in The Works of The Stanley Electric Manufacturing Co., Pittsfield, Mass.

Electric Company a large two-phase S. K. C. alternator, which has been running continuously for many weeks, furnishes the current which drives the shop machinery.

IV.

THE office building, which immediately adjoins the main works, is a separate structure, three stories high, 35 x 80, built of brick with stone trimmings. The lower floor contains the offices of the general manager and his assistants, the offices of the sales department, telegraph and long distance telephone offices, and is fitted with all the appliances of a modern business office. On the floor above are the treasurer's office and those of the superintendent of the motor department, the book-keepers and the offices of the electrical engineers and their assistants, together with the library, which, we may add, is one of the most complete shop libraries we have yet seen. The top floor contains the draughting rooms, the photographic rooms, and blue-printing rooms. A part of this floor is also devoted to a room for testing purposes and is equipped with the most modern instruments for that purpose, including Kelvin balances, D'Arsonval ballistic galvanometer, Weston voltmeters, etc. In this room the complete curve of electromotive force of the alternators is traced and checked by various methods.

In order to insure the integrity of the many valuable records and drawings, which represent the work of years, part of the cellar under the office building has been fitted up as a vault for the reception of records. The remaining portion of the cellar is employed as a stock room for small supplies required by the adjoining main shop.

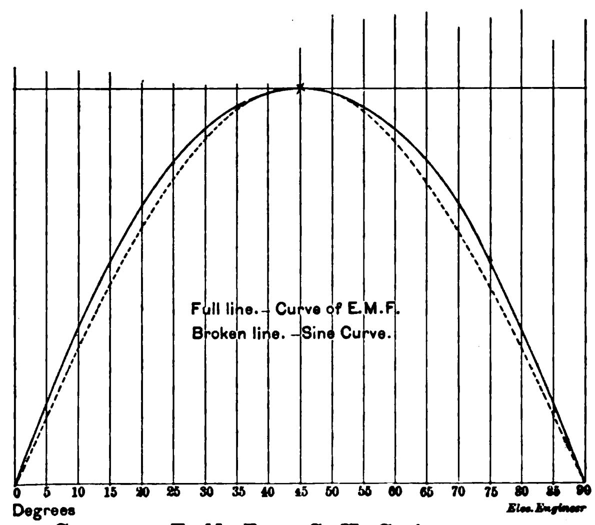
V.

The new shops of the Stanley Co. are devoted exclusively to the construction of their 2-phase generators and motors, and it may not be uninteresting to trace briefly the history of their growth.

When some three years ago the Stanley Co. were ready to place their two phase motor on the market, they discovered that, unfortunately, no market existed and that they would have to create one. There were no two-phase generators in use, and without these, of course, the motor was practically valueless. Their first efforts, therefore, were directed towards obtaining from some existing generator building companies suitable generators; but it was found impossible under any reasonable conditions to get generators of the kind and quality desired. They were, therefore, practically driven to attempting to develop a generator of their own, suitable for the distribution system they had in view. Their aim was to create a generator simple and robust in design, highly insulated, of high efficiency, and good regulation, the latter point being especially necessary at high frequencies. They decided at once that to obtain these ends, the armature coils should be stationary, and as the design progressed, they added to this the requirement that none of the wire should be subjected to motion.

It was necessary, for the successful operation of the motors that the electromotive-force curves of the generator should be smooth and even-flowing, and as nearly sinusoidal as possible, since it appears to be acknowledged by all that the sine curve is "second best." The old surface wound armatures gave pretty fairly even curves, but the construction was unsubstantial. On the other hand, while the construction in most of the modern grooved armatures is fairly substantial, the curves are apt to be irregular. They have attempted, and they think with success, to steer clear of both defects. The wire is imbedded in the armature coil, but on account of the relatively small space occupied by it and the peculiar shaping of the pole pieces of the inductor, the curves are even and smooth. It might be thought by one hastily examining the construction as shown in the engraving on page 191 that the grooves belonging to one circuit would materially interfere with the shape of the electromotive force curves given by the other, but in practice this is not found to be the case, as shown by the diagram on this page which gives the true sine curve in dotted outline beside the curve actually obtained.

The machine consists essentially of a revolving inductor of steel, shown on page 190, with two sets of laminated pole pieces, those at one end of the inductor being all of north polarity and those of the other of south. The magnetizing coil lies midway between the two sets of poles, but is supported independently of the inductor so that the latter turns freely inside it. The armature portion of the machine consists of two laminated iron rings connected by wrought iron bars; or, in the case of the smaller machines, by wrought iron bars and a cast iron bridge. The relative densities of the magnetization in the various parts of the machine are so chosen that the flux through this bridging portion of the apparatus is perfectly steady and so there are no eddy currents caused here by the rotation of the inductor. As the disturbing effects of self-induction of circuits is greater the higher the frequency, other things being equal, the reaction on the generators would be worse, and it is therefore necessary in building machines for a high frequency to provide that their inherent regulation for a given current and lag should be higher than for

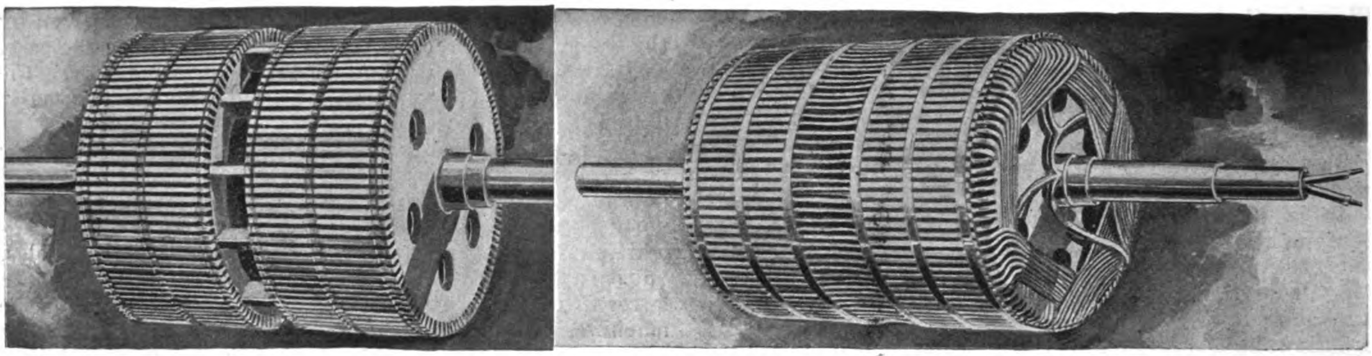


CURVE OF E. M. F. OF S. K. C. ALTERNATOR.

machines for low frequency. Other things being equal in two machines of the same dimensions and same output, this is automatically effected by the mere increase of the number of the armature coils and the decrease in the number of turns in each coil.

As a rule, however, other things are not equal, because to maintain the same magnetic density will require the same magnetomotive force per magnetic circuit, and with the increase in the number of magnetic circuits required for increased frequency there fails to be room for the magnetizing winding. In the S. K. C. machine, however, the magnetizing winding is exactly the same, no matter what the frequency. The various magnetic circuits being merely parallel branches of one main circuit, their number can be increased at will, the density remaining the same. The efficiency of the machine even of relatively small sizes, is remarkably high, machines of 150 K. W. or thereabouts having shown on test an actual commercial efficiency of over 93.5 per cent.

On account of the manner in which the armature coils are placed, it is practically as easy to insulate them as to insulate the coils in a transformer, and in consequence of this machines may be directly wound for such voltages that in most cases of long distance transmission the use of step-up transformers may be avoided. This, of course, is a considerable element to be taken into account in



ARMATURE OF S. K. C. TWO-PHASE MOTOR, UNWOUND AND WOUND.

estimating the real cost and efficiency of the generator element of the plant. Machines of 150 K. W. capacity have been directly wound for 5,500 volts. Higher voltages could be had if desired and the larger the machine, the easier it is to apply the high tension winding. The standard sizes of machines at the present time are 75, 150, 300, and 500 K. W.; these are made for 8,000 and 16,000 alternations; but the Company are prepared to build machines of any size that may be ordered.

VI.

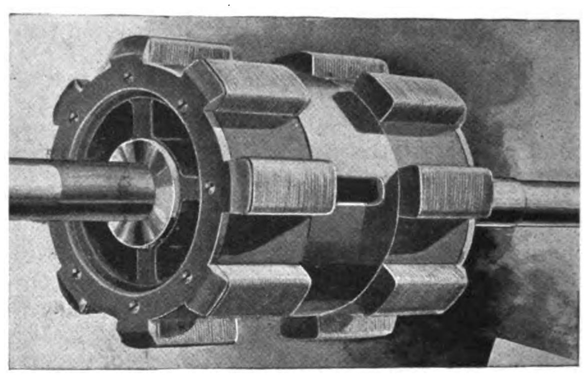
The Stanley Company from the very start have kept in view the fact that practically all alternating stations in the country were operating at 16,000 alternations and that to obtain recognition their apparatus must conform to this frequency. To construct a practical 2-phase motor at such a frequency was no simple problem, but active experiment soon evolved a type of machine which has proved its efficiency after a time test now extending over many months.

The S. K. C. two-phase motor, illustrated on page 186, consists of two parts, a motor proper and a rotating transformer, the two parts alternately exchanging their functions. There are, electrically speaking, two fields, which are fed by currents differing 90 degrees in phase, and two armatures, though mechanically there is but one, as shown on this page. The winding is so connected that the wire which lies directly under the poles on one armature is in series with the wire lying between the poles on the other. In this position, therefore, one-half of the machine acts as a transformer and the other half as a motor.

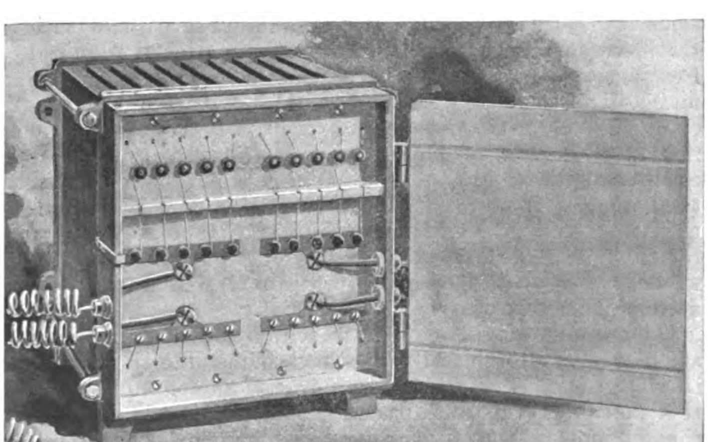
The armature is shown wound and unwound, on this page; it will be seen that the winding is not connected with the circuit and consequently the only current flowing in it is an induced current.

The field construction is shown on page 191. The coils are wound separately and then secured in place, and are the only part of the motor connected with the circuit. Being stationary, they are easily insulated and take an applied E. M. F. of 500 volts. A "compensating winding" is employed which consists of short circuited coils of high conductivity placed in the field poles for the purpose of neutralizing the self-induction of the armature. This construction increases the starting torque of the motors from 50 to 200 per cent. above the running torque at full load.

A unique and striking feature of this motor system is the use of the condenser, whose function is to make the motor take current in proportion to its load. These condensers shown on this page are connected in multiple with the fields of the motor, and when so placed, supply the lagging component of the current. Thus with this arrangement the false currents, instead of flowing back through the transformer line and generator, and disturbing the whole system, simply flow in a local circuit through the condensers. Alternating current motors and lights can thus be successfully operated from the same generator and circuit.



INDUCTOR FOR S. K. C. TWO-PHASE GENERATOR.



CONDENSER FOR S. K. C. TWO-PHASE MOTOR.

VII.

The rapid progress of the Stanley Company can be shown in no better way than by comparing the dimensions of the new shop with that of the old, the exterior of which is illustrated on page 192, and of which we give other views on the same page. The entire building of this old shop is now used exclusively for transformer work and it is operated by the first two-phase motors built by the company, which have now been running for nearly two years. An interesting department of the transformer work is that of testing, illustrated on page 187. The transformers are here tested up to 9,000 volts and complete records of regulation, heating, efficiency, etc., are kept. It was in this department, not long ago, that one of the assistants, was "hung up" on a circuit carrying 4,500 volts, alternating, for a short while, but had quite recovered a few hours afterwards and was able to go on with his usual work the fol-

lowing day, artificial breathing having been resorted to, to restore consciousness.

In this shop also the condensers used in connection with the alternating motors are manufactured. These are built up of tin foil with oil paper insulation, which is then treated so as to remove the last traces of air from between the sheets and from the insulation. They are built up of one-half micro-farad slabs about half an inch thick, and one foot square, enclosed in tin boxes, and are assembled in the manner shown on page 190.

All the machinery in this building is run by the S. K. C. two-phase motors. Thus, a 7 H. P. motor runs the tools in the carpenter shop, having been in operation for a year and a half. Another, a 10 H. P. operates the transformer shop and the elevators. One 6 H. P., the winding department, and another, on the third floor, of 10 H. P. runs a number of miscellaneous small tools.

From the very first, the Stanley Company recognized the importance of good insulation, and have accordingly devoted not a little attention to this part of their apparatus. A special insulating shop, shown on page 192, has been equipped with special devices for treating the transformer and armature coils, and the efficacy of the processes is made evident by the almost absolute immunity from break-downs in the insulation of the S. K. C. machinery. The insulating shop is also operated by alternating motors.

VIII.

Having described the apparatus and the principles underlying them, it may not be out of place to indicate briefly the actual work now being carried on practically with the S. K. C. system. We have already alluded to the Company's own use of their motors in the shops, but other interesting application can be seen in daily operation in Pittsfield, where a two-phase power distribution plant has been in regular operation for nearly two years past.

At the Pittsfield Electric Light Company's station a 120 K.W., two-phase S. K. C. generator has been running, day and night, for the past five months, supplying all the circuits around town, in addition to the shops of the Stanley Company as mentioned above. On this circuit we find a 15 H.P. motor in the printing office of the Eagle Publishing Company, driving 4 cylinder and a number of Gordon presses, which have been running for the last 18 months. A quarter of a mile away is a 1 H. P. motor in the drygoods store of England Brothers, running the cash system, and close by the latter, another 1 H. P. motor in the store of Kennedy & McInnes. These motors are attended to by the cash boy and require no starting arrangement whatever.

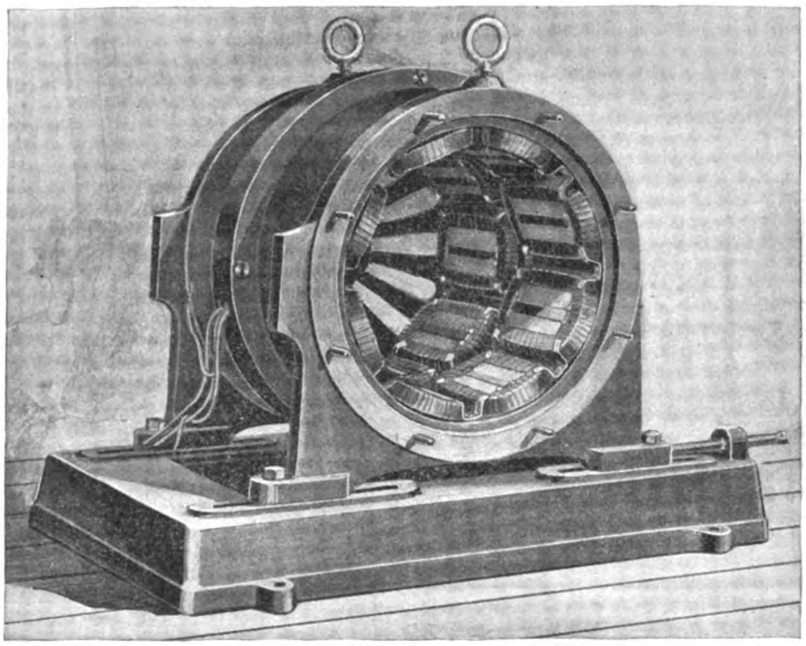
Passing beyond the confines of Pittsfield we find that the United Electric Light Co., of Springfield, Mass., has a 350 K. W. two-phase 3,600 volt generator at a water power at Indian Orchard, 6½ miles distant from its station. The current is brought to the station and is there diverted into the company's city system through their regular switch boards. The current is also used to operate synchronous motors in the station, and induction motors for power purposes are also operated from the two-phase circuit.

The Montmorency Electric Power Co., of Quebec, P. Q., Canada, is now operating two 240 K. W. generators at Montmorency Falls, eight miles from that city. These generators are connected in parallel and have been in service for several months. This same company has purchased three 500 K. W. generators which will be installed as soon as finished, and they are now building a very complete sub-station in the City of Quebec from which to distribute the power from these large generators. Current will be used for both light and power purposes and the system will be complete in every detail. Special switch boards for both generating and sub-station are being made and special arrangements will be made for ventilation of the step-down transformers. The generators are wound to deliver 5,000 volts at the end of the line and no step-up transformers are used.

The Suburban Electric Light Co., of Tacony, Pa., near Philadelphia, has one 240 K. W. 2,000 volt generator. This plant has been in operation for nearly a year running both motors and light.

The Anderson Water, Light & Power Co., Anderson, S. C. is now installing a 150 K. W. generator eight miles from the centre of distribution. This generator is wound for 5,500 volts and the current will be used for supplying a 30 H. P. motor, for the pumping station in Anderson and various sized motors for general power purposes and for lighting.

The Danville Gas Elec. Light & St. Ry. Co., Danville, Ill. is operating a 120 K. W. generator and has purchased a 240 K. W. generator which has just been shipped. This is



S. K. C. Two-Phase Motor with Armature Removed.

used for light and power purposes about town. Finally we may mention that the Peoples Power Co., Moline, Ill. is operating a 120 K. W. generator for both light and power. This generator has been in operation about four months.

The plants cited will give a fair idea of the character of the work which has been done. In addition to the generators mentioned there are to-day in operation in the United States 14 60 K. W. generators, 4 of 150 K. W., 2 of 240 K. W.; all used where it is desired to supply both

THE OLD FACTORY.

THE NEW SHOPS.

light and power from the same circuit; and the use of induction motors is rapidly growing. Besides the business in the United States, the Stanley Electric Mfg. Co. has shipped one 60 K. W. and two 80 K. W. generators and a number of motors of various sizes to Japan which are being used there in long distance transmission work. The record thus far of the Stanley Co.'s system is forty two generators actually in use or sold since the system was first introduced ranging in size from 80 H. P. to 700 H. P. each and aggregating about 8,000 H. P. total capacity.

METHOD FOR OBTAINING ALTERNATING CURRENT CURVES.

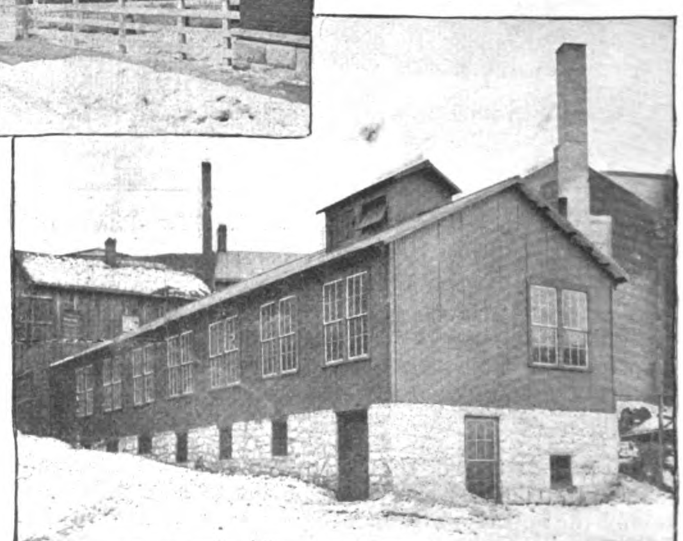
BY

Louis Duncan.

In some cases a telephone method for obtaining the curves of alternating currents and electro-motive forces is very convenient.

The method ordinarily employed for obtaining current curves is to shunt from a non-inductive resistance in the circuit, and include in the shunt circuit a contact making arrangement on the dynamo shaft, a telephone, and an electromotive force, due to a constant current. This constant current is adjusted until there is silence in the telephone. When this occurs, the fall of potential due to the alternating current is equal to the fall of potential due to the continuous current, and knowing the latter, we get the value of the alternating current at the instant the contact on the shaft is made. Electromotive forces may be obtained in the same way by balancing a continuous electromotive force against the instantaneous value of the alternating electromotive force when the contact on the shaft is made.

There are several difficulties in this arrangement. Any small thermal electromotive force at the contact, makes it difficult to get even an approximate balance, while only one curve may be obtained from a single contact-making-arrangement on the shaft. I have employed with some success, a method in which some of these difficulties are eliminated. To a telephone diaphragm, made preferably of mica, I attach a small coil of fine wire. Beneath the diaphragm are two coils wound together, and so placed that the diaphragm coil is in a magnetic field due to currents flowing in them. Through the diaphragm coil, I send instantaneous currents obtained from a contact-making device on the shaft, there being a battery in circuit with the coil and the contact-maker. Through one of the stationary coils, I send a current proportional to the electromotive force to be measured, or a current obtained from a shunt on a non-inductive resistance in the dynamo circuit. The other coil has a continuous current flowing through it, which latter is measured. I now adjust the continuous current, until the sound in the telephone is zero. If the coils are equal, this will mean that the continuous current is equal to the instantaneous value of the alternating current



THE INSULATING SHOP.

when the intermittent current is made. The method is independent of any small electromotive forces due to the contact, and any number of curves may be obtained from the same contact-making device. This method, though fairly sensitive, has the difficulty that unless the contact only lasts for an infinitely short time, there will always be a sound in the telephone. By making a sharp contact, and after some practice the results are good.

MR. C. H. WILMERDING.

C. H. Wilmerding.

The new president of the National Electric Light Association, Mr. C. H. Wilmerding, of Chicago, was born in 1858, in New York City. He received his earlier education in Germany and France, but entered Yale, in the Sheffield Scientific School, and graduated in 1879. He began his professional career as a civil engineer, with work in the same year on the new waterworks at Troy, N. Y., and seized the opportunity to take at the same time a special course at the Troy Polytechnic in mining and metallurgy. Mr. Wilmerding then went west and spent two years as a mining engineer in the new camp at Leadville, which he saw grow from 400 inhabitants to 30,000 in about twelve months. He and his partner, an Englishman, enjoyed a most lucrative practice, while the wonderful Leadville boom lasted. They who know Mr. Wilmerding will not be surprised that even as one of its first 400, he found the silver camp rather tiresome. He soon found his way into steam railroad construction and built a considerable portion of the Denver & Rio Grande Western, between the Colorado State Line and Provo, Utah. As a rest from this arduous work, Mr. Wilmerding made a European trip, and on his return became an Assistant Engineer in 1886 on the New York Aqueduct, an engagement which he followed up with construction work on the Yonkers extension of the New York & Northern. In 1888 he was invited to Chicago, where he became connected with the Chicago Arc Light & Power Co., first as superintendent, then as general manager and finally as president. A consolidation was effected with the Chicago Edison Co. in 1893, since which time, Mr. Wilmerding has been general superintendent of the latter immense corporation, whose work was so fully described in THE ELECTRICAL ENGINEER of Jan. 23, 1895.

From the very beginning of his electric lighting work, Mr. Wilmerding has taken an active interest in the growth of the National Electric Light Association, which he believes in thoroughly, and to whose proceedings he has contributed from time to time. He has attended the meetings regularly, and has used his influence to secure the support of the Association by the larger companies like his own. His professional qualifications are of the highest, and his personality, while not of the kind usually characterized as "magnetic," is one that wins growing esteem and respect from year to year. He is a clear and concise speaker, not overfond of debate, but always ready and able to take a helpful share in any discussion touching practical and technical topics. He has already served the Association in various capacities, and now passes to the presidency from the position of first vice president. His election is the more gratifying to those who know him from the fact that it came entirely unsought. His name had been mentioned more than once before in connection with the office, but Mr. Wilmerding always declined positively to seek a nomination and requested earnestly that his candidature be not urged. In now making such a choice, the Association, it is felt, honors itself, Mr. Wilmerding and the professions he represents.

CORRECT METHOD OF PROTECTING ELECTRIC CIRCUITS.[1]

BY W. E. HARRINGTON.

The practical interpretation of Helmholtz's formula indicates clearly that if a circuit be opened during the rise or first surge in current upon a tendency for abnormal flow, and further, if the time of opening be made as quickly as possible, the less the resulting flow of current will be. The author illustrated this point by diagrams embodying the results of experiments.

The heretofore standard form of magnetic circuit breaker, and the type familiar to all, is immeasurably preferable to fuses, in so far as it opens the circuit much quicker on the score of time. Fuses open the circuit so late after the heavy, unusual condition of circuit is established that the current reaches the high and parallel part of the current curve.

A magnetic circuit breaker should be constructed to open the circuit in less and less time as the conditions become more and more severe. This can be done by taking advantage of the flux of lines of force due to the passage of the current, since, fortunately, the two are simultaneous; and by designing the magnetic circuit breaker to open as regards time in an inverse ratio to the increase of the lines of force, and not depending on springs or gravity, except, possibly, as auxiliaries to act as potential energy to aid in overcoming the inertia of the switch jaws and arms. We have then the correct method of protecting electric circuits.

The destruction of electrical apparatus, the breaking down of insulation, the burning out of circuits, is taken by the business managers of electrical stations with a meekness and a non-effort for relief which is astonishing. What business manager would permit his boilers to run with safety-valves of such a type that an increase of 500 to 1,000 per cent. of pressure would be required to open them? The writer has repeatedly made tests showing that a No. 21 B. and S. gauge copper wire would permit the passage of 450 amperes for $\frac{8}{100}$ of a second without burning out, or changing color. All switchboards and minor lighting circuits should be protected by automatic (as regards time element), magnetic circuit breakers, and the urgency of this will appeal to the exchequer of the management of our many electric light and power stations when the full meaning and import of Helmholtz's law dawns upon them.

1. Abstract of a paper read before the N. E. L. A., Cleveland, February 19-21, 1895.

REPORT OF N. E. L. A. COMMITTEE ON STANDARD RULES FOR SAFE WIRING.[1]

At the last meeting of the association the rules were carefully revised, and in the opinion of your Committee but slight changes could be desired. Recent work of your Committee indicates that in the near future joint meetings will be held with committees of the Underwriters, Street Railway Association, Telephone, and other interests, which will be productive of much good, and will enable a very satisfactory report to be made at the next meeting. In view of the above, your Committee recommend that the present rules will be approved and continued.

1. Submitted at the Cleveland Meeting, Feb. 19-21, 1895.

LITERATURE.

Electrical Engineering for Electric Light Artisans and Students. By W. Slingo and A. Brooker. New and Revised Edition. New York. 1895. Longmans, Green & Company. 5 x 7½. 753 pp. Price, $3.50.

The first appearance of this work in 1890 was followed by four reprints, but the progress of the art has induced the authors to thoroughly revise their original work, which they have brought down to date. The work is too well known to require any detailed review at this late day. In looking over the pages it occurs to us that possibly a little more attention might have been devoted to electric railway work. The apparatus illustrated in that department is, for the most part, several years old, and the work done within the last few years might well have furnished material for a separate chapter. The book, nevertheless, continues to be one of the best of its class.

MR. W. A. STADELMAN.

From March 1, the Elwell-Parker Electric Co. of America will be represented in New York City by Mr. W. A. Stadelman, with offices in either the Havemeyer or the Central Building. He will also represent the Brown Hoisting and Conveying Machine Co., acting as General Eastern Manager for both of these important Cleveland concerns. For the past three years Mr. Stadelman has been associated with the Niles Tool Works, with whom his relations have been of a very pleasant nature. He parts from that concern with regrets on both sides, but it is not to be wondered at that Mr. Stadelman should turn again to the electrical field. It will be remembered that Mr. Stadelman was once with the Sprague Electric Railway Co., later with Chadbourne, Hazelton & Co., and then in business on his own account as the engineer and manager of the Equitable Construction Co. While the introduction of the Niles tools in electric railway plants has kept him more or less in touch with old friends, it will be evident that even larger and better electrical opportunities now await him. Mr. Stadelman may be depended upon to make the most of them. He has youth, energy, experience and the esteem of a wide circle, and has, moreover, the representation of apparatus that has achieved the highest repute. As an acquisition to the commercial engineering ranks in New York, Mr. Stadelman will receive a warm and hearty welcome.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIX. NEW YORK, FEBRUARY 27, 1895. No. 356.

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THE NEXT STEP.

In these days of retrenchment and small economies it behooves the station manager to study and to develop all possible means which will increase the current output of the station. More particularly is it desirable that those sources of current consumption should be encouraged which will help to make more uniform the load diagram and bring up the load factor of the station. By comparison with European stations, American central stations show far higher load factors, due largely to the motor work which brings up the day load. But while there is still much that can be done in developing motor work there are other paying outlets for current which ought not to be neglected, and one of the principal among these is electric heating. The applications for current intended for heating may be divided broadly into two classes : First, that in which the current is applied for the specific purpose of heating a tool, implement or apparatus ; secondly, the general heating of buildings and living apartments. As far as the latter is concerned, we are not of those that believe that electric heating can with economy take the place of steam direct on a large scale, and still less in such cases where exhaust steam from engines is employed for heating purposes. But on the other hand we believe that conditions are not infrequently met with where the heating of apartments by electricity can be economically carried out. A striking example of this is afforded by an installation recently made by Messrs. Crompton & Co. in the Vaudeville Theatre, in London, where electric heating apparatus ordered at eleven o'clock in the morning was in position and at work at six in the evening. Intended as the plant was at first merely to tide over an excessively cold period, the management were so well pleased with the portability, perfect regulation and freedom from danger of the electric method that they have decided to equip the theatre permanently with electric heaters, and we have no doubt that they will soon be followed by others. But it is rather in the direction of electrically heated apparatus used in manufacturing establishments and for domestic purposes that we expect to see the largest and most immediate developments attained. On another page in this issue Mr. H. Ward Leonard shows what has heretofore stood in the way of the more extended application of such apparatus and the means which he has employed to overcome these difficulties, namely, by reducing the body to be heated to the smallest possible dimensions and by the direct application of the heat to that body. In order to bring out vividly the true relationship between the current consumed and heat evolved, Mr. Leonard has added a table of equivalents which will answer directly many of the questions that the intending user of electric heating will be likely to ask. On the face of it the results shown in this table might appear in some cases unfavorable to the application of current. Leaving out the question of convenience which, indeed, in many instances may be a determining factor, it must be borne in mind that in most shops and domestic applications heat is employed intermittently, so that the time of actual application compared with that during which no heat is required is but a small percentage. But while with the older methods a continual consumption of fuel is necessary in order to have the heat exactly at the instant when it is wanted, no such waste of energy is entailed in the case of the electric current, and hence while according to Mr. Leonard's table it would require eight cents at the usual rates for electric energy to raise 22 pounds of water from 62 degrees to the boiling point, the coal consumed in a stove lying idle for the best

part of the day probably more than exceeds the cost of current required to do the work of the stove during the time that it is actually employed in heating. To this must be added the high efficiency of the electric heater as compared with the ordinary stove which does not exceed 5 or 6 per cent. in efficiency. With the economy of electric heating apparatus raised to a reasonable figure we believe that it will assume a position of great commercial importance in the art. Domestic electrical heating apparatus will gradually change from a luxury to a necessity, just as the electric light and electric motor, by their superior qualities, have outrivalled gas and the steam engine, in spite of the odds apparently against them.

THE CLEVELAND CONVENTION.

Probably when the recent meeting of the National Electric Light Association at Cleveland has duly settled down into its place in the perspective, it will seem to a good many that the most notable event was the presence of Mr. Brush. Few of the members had ever seen him before, few will ever see him again. His own pithy little speech showed how thoroughly he had withdrawn from active participation in electrical work—a thing to be deeply regretted, but certainly of his own choice. In many ways his words of welcome and farewell were typical of the situation, for he was greeted as the foremost exponent of the arc lighting system and of the conditions that have so largely controlled the course of events during the first ten years of the Association's history. The arc light is a large element but no longer dominates, and hardly an old arc light station to-day is satisfied with limitation to that class of work. While in various respects the programme of the meeting gave evidence that permanence had been reached in some branches of the art, it is none the less true that the Cleveland convention marked the beginning of a new decade, with new ideas, new men, and new hopes. It was right and well that the Association should have thus saluted an old leader, dipped its colors with admiring courtesy, and marched bravely on.

The late president, Mr. Francisco, has the satisfaction of knowing that the Association maintained its growth and prosperity through a year of trial, and that with the revival of industry there is every prospect of an increase in the membership. The Association is fortunate in enjoying the services of such a hard worker as Secretary Porter, and is now, we think, heartily to be congratulated on its selection of Mr. Wilmerding as its president for 1895–6. That gentleman has well nigh every quality one would wish in the occupant of the chair of such a body, and nothing but his reserve and diffidence prevent him from being even more conspicuous in public affairs than this honor can make him. In culture, natural ability, high sense of honor, intimate knowledge of the electrical art and industry, and an enthusiastic belief in the future of the Association, Mr. Wilmerding ranks high among its presidents; and we know that he will strive to make his year of office memorable by arduous effort and worthy achievement in its behalf. The best service he can render is to enlist in its ranks more men of his own stamp.

The subject which formed the title of Mr. N. W. Perry's interesting paper read before the Association is one of the utmost importance, and we regret that the limits of space do not permit us to go more into the details by which the author arrives at the suggestive results given elsewhere in this issue. We are fully in accord with Mr. Perry, in the conviction that economies should be practiced at all points in the course of the generation of current, but we fail to see as clearly as he does how the equalization of the boiler load can overcome the losses due to underload in the engine cylinder. Not that boiler economy is not a good thing to strive for, but it can hardly be put on a level with the steam economy in the cylinder, comparing the two on the basis of actual fuel consumed at full load and light load. As to the place assigned to the storage battery, the discrepancies in cost pointed out by those who discussed Mr. Perry's paper are sufficient to account for the unlooked for results obtained by the author. But we think that all arguments must fall in the face of the later facts which are now, and have been for some time past, undisputed, and which go to show that the storage battery in many central stations *does* work for economy, and *is* a practical success, not only abroad but even in the limited number of stations in which it has been introduced in the United States. Mr. Edgar's tribute to it must be final among all those who know that engineer's conservative character. He does not deny that the battery requires careful handling, but it would be small credit to the intelligence of American central station electricians if they were unable to do what has been done successfully in hundreds of instances abroad. If necessary, however, we still have the alternative of importing fifteen-dollar-a-week Germans to look after our batteries for us. However, we are glad that Mr. Perry put the subject as he did, in a manner sure to elicit valuable discussion.

When the Association at Washington, last year, adopted the resolution defining the nominal 2,000 c. p. arc as one consuming 450 watts, it scarcely supposed that this rating would be so soon attacked, and, least of all, by some of its own members. The paper read by Mr. L. B. Marks, and the discussion thereon, go to show once more that rules in the electrical industry are difficult to establish and more difficult still to maintain. In the case of the arc, particularly, the more investigation is extended the plainer it becomes that we are here dealing with a most unstable quantity. Even with the electrical factors, such as current and potential difference maintained at a fixed point, the quality of the carbons employed has such a marked effect on the candle power that no rule can be given that will cover all cases. A glance at Mr. Marks' table will show this in a striking manner. In the face of the constant efforts towards securing purity in carbons, Mr. Marks takes the somewhat heretical view that absolutely pure coke carbons, if such could be commercially manufactured, are not well adapted to existing commercial arc circuits, because the average potential difference required for a steady arc with pure coke carbon is considerably greater than that required by ordinary carbons—another instance in which commercial practice contravenes the ideal conditions. While it was again abundantly shown that the quality of the carbon has a most important bearing on the relation of watts to candle-power, we still believe that until a better standard of arc rating is available, the Association's 450 watt rule is about as good as can be followed for the present. It seems certain, however, that at no distant date some recognition in drawing city contracts must be given to *illumination* as distinguished from *candle power*, and that the place to measure the light is at the surface to be illuminated and not at the source of light. In spite of its alleged drawbacks, the "illuminometer" of Prof. Houston and Mr. Kennelly, may prove a valuable factor in determining a constantly recurring question.

EIGHTEENTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION—CLEVELAND, FEB. 19-21, 1895.

THE eighteenth convention of the National Electric Light Association was called to order by President Francisco in Army and Navy Hall, Cleveland, O., on Feb. 19, at 11 a. m.

The following were in attendance:

NEW YORK:—P. C. Ackerman, H. C. Adams, L. R. Alberger, P. H. Alexander, Jas. I. Ayer, Mr. Badger, A. C. Bakewell, Chas. S. Bradley, J Burke, Capt. W. L. Candee, C. E. Carpenter, E. A. Colby, S. L Coles, F R. Colvin, H. M. Davis, Frank De Ronde, S. A. Douglass, C. R Duffy, H. A. Foster, C. Gallagher, Mr. Gardiner, B. E. Greene, F. W. Harrington, H McL. Harding, A. B Herrick, E. M. Higgins, W. T. Hunt, W. J. Johnston, J. F. Kelly, H. Ward Leonard, C. A. Learned, L. Lindsey, R. W. Little, Romaine Mace, C. P. Mackie, W. H. Mackie, W. J. MacConnell, L. B. Marks, T. C. Martin, J. McGhie, Thos. McCoubray, Geo. T. Manson, P. L. McLaren, J P. McQuaide, T. A. Olmsted, W. F. Osborne, N. W. Perry, G. M. Phelps, Cecil P. Poole, Geo F Porter, A J Purrington, J. A. Seely, C D. Shain, J. E. Smith, Louis Stirn, L. Stieringer, H L. Shippy, C. E. Stump, H. M. Swetland, H. H. Walter, Wm. Weierbach, J. E. Way, H. C. Whitney, G. L. Wiley, E. E. Wood, H. L. Cragin, C. I. Hills, J. Sachs, F. H. Prentiss, S. M. Young, G. W. Wise.

CHICAGO:—H. M. Angle, M. B. Austin, W. P. Bartholomew, Dr. Louis Bell, Hugo Benedix, E. H. Burrell, C. G. Burton, A. B. Conover, Jr., J. H. Cooke, E. W. Cooke, Geo. Cutter, C. H. Cutler, Mr. Clendenin, W. F. Collins Geo. W. Conover, Fred. DeLand, F. E. Donohue, H. A. Douglas, C. B. Fairchild, E. H. Fox, J. H. Gates, C. E. Gregory, T. H. Grier, J. A. Hersey, G. A. Hurd, W. S. Hine, A. Hoppin, Mr. Hurlitz, C. Kammeyer, W. E. Kelly, J. H. Livsey, W. W. Low, Geo. A. McKinlock, W. B. McDonald, Carl K. McFadden, W. H. McKinlock, C. S. Marshall, S. F. B. Morse, E. Nashold, J. B. O'Hara, F. L. Perry, E. L. Powers, R. J. Randolph, Alb. Sheible, A. L. Searles, J. C. Shainwald, Geo. S Searing, M. A. Sullivan, H. M. Sperry, M. J. Sullivan, B. E. Sunny, H. F. Tate, J. S. Tebbetts, F. S. Terry, J. B. Wallace, C. J. Wells, C. H. Wilmerding, C. D. Wilkinson, M. M. Wood, Jas. Wolff.

CLEVELAND:—F. Abbott, D. M. Barr, W. H. Bone, Chas. F. Brush, W. B. Cleveland, J. D. Climo, Webb C. Hayes, Mr. Hedges, H. E. Higgins, H. W. Hill, Mr. Hoag, Geo. Hoyt, S. M. Hamill, S. S. Leonard, E. B. Merrian, B. F. Miles, J. C. O'Neill, J. Potter, C. H. Rockwell, E. P. Roberts, S. H. Rogers, W. E. Rogers, E. A. Sperry, Prof. S. H. Short, Prof. B. F. Thomas, Chas. W. Wason, D. J. Wason, W. H. Waugh, W H. Lawrence, R. Lindsay, S. Scovil, C S. D. Johns, Prof. J. W. Langley, H. F. Hackenburg, S. E. Cox, T. A. Boardman, J. M. Strong, E L. Nash, A. E. Brown, A. Spiller, A. D. Dorman, T. E. Adams, A. H. Hough, W. H. Bosworth, N. S. Possons, W. E. Irish, F. C. Phillips, F. Billings, R N. Baylis, E. S. W. Moore, G. R. Lean, J. R. Massey, B. Whipple, E. B. Phillips, W. Jandus, P. C. Burns, A. Moore.

BOSTON:—W. H. Atkins, F. E. Barker, H. H. Brooks, J. H. Burghardt, H. B. Cram, C. L. Edgar, F. A. Gilbert, C. H. Herrick, C. W. Holtzer, E. B. Kittle, Normal Marshall, J. H. Parker, E. A. Record, E. N. Sanderson, A. C. Shaw, D. R. Urquhart, J. S. Wilson, J. R. Lovejoy, H. E. Hall, C. J. H. Woodbury.

PHILADELPHIA:—C. A. Bragg, W. E. Harrington, E. J. Houston, A. E. Kennelly, Chas. W. Mason, J. Mustard, J. A. Pentz, R. B. Smith, T. Carpenter Smith, S. B. Wheeler, E. Ward Wilkins, W. D. Pickles.

PITTSBURG, PA.:—J. S. Crider, M. Crompton, H. P. Davis, Geo. B. Dusinberre, F. H. Heinrichs, J. C. Hubner, B. Lamme, R. D. Mershon, J. W. Marsh, J. A. Rutherford, C. F. Scott, H. D. Shutte, F. S. Smith, C. Townley, L. W. Washington, A. J. Wurts, W. A. Stadeleman, C. F. Scott, C. A. Terry, J. S. Humbird.

ATLANTA, GA.:—H. T. Edgar, O. Turner.

ALTOONA, PA.:—E. B. Greene, W. Markland.

AKRON, OHIO:—Chas. B. Raymond.

BETHLEHEM, PA.:—Albert Fisher, H. F. J. Porter.

BIRMINGHAM, ALA.:—I. Ullman.

BISBEE, ARIZ.:—John Langton.

BRIDGEPORT, CONN.:—W. C. Bryant.

BROOKLYN, N. Y.:—T. E. Crossman, Jos. Sachs, Louis Winter, E. F. Peck.

BUFFALO, N. Y.:—C. R. Huntley.

CINCINNATI, O.:—Jas. C. Hobart, Thos. J. Creaghead, S. W. Glover.

COLUMBUS, O.:—E. M. Poston.

CRAIGIN, ILL.:—C E Bonnell.

CUYAHOGA FALLS, OHIO:—E. L. Babcock, C. A. Babcock.

DAYTON, O.:—Edmund Dickey, G. A. Gessner, A. A. Thresher, E. O. Waymire.

DES MOINES, IA.:—J. A. Colby.

DETROIT, MICH.:—J. E. Lockwood, J. Cummings.

DOLGEVILLE, N. Y.:—Mr. Millet.

FORT WAYNE, IND:—C. S. Knight, T. J. Ryan, T. Cooper, C. E. Wilson.

HARTFORD, CONN.:—J. J. Gates, E. B. Hatch, C. E. Newton, C. L. Tolles.

FOSTORIA, O.:—J. P. Crouse.

FREMONT, O.:—M. Richmond.

GRAND RAPIDS, MICH.:—S. Barnes.

HARRISON, N. J:—W. S. Howell, A. D. Paze.

HILLSDALE, ILL.:—L. W. Greene.

HYDE PARK, ILL.:—W. M. Chase, J. W. Ware.

INDIANAPOLIS, IND.:—E. P. Morris, C. Jenney, Mr. Hadley.

KNOXVILLE, IOWA:—H. S. Conner.

LYNN, MASS.:—C. E. Harthan, Prof. Elihu Thomson.

LONDON, ENG.:—Edward Bergtheil.

MARION, IND.:—A. J. Butler.

MILWAUKEE, WIS.:—S. G. Coleman.

MINNEAPOLIS, MINN.:—B. B. Downs.

MONTREAL, CAN.:—A. J Corriveau, J. A. Kammerer.

NEWARK, N. J.:—C. O. Baker, Jr., R. O. Heinrich, C. H. McIntire.

NEW CASTLE, PA.:—D. F. Flick.

NEW BRITAIN, CONN.:—T. H. Brady.

NEW BRUNSWICK, N. J.:—H. A. Jones.

NEW HAVEN, CONN.:—E. H. Phipps.

NORFOLK, VA.:—Jas. L. Blote.

PARIS, FRANCE:—E. W. Mix.

PERU, IND.:—J. H. McGill.

PITTSFIELD, MASS.:—Henry Hine, John F. Kelly, W. R. Gardner.

RAVENNA, O.:—C. L. Rodman.

RUTLAND, VT.:—M. J. Francisco, I. Holmes Francisco, D. C. Francisco, J. F. Flanagan.

ROCKFORD, ILL.:—M. A. Beal.

ROCHESTER, N. Y.:—C. F. Burns, F. M. Hawkins, Mr. Kettle, Geo. A. Redman.

ST. LOUIS:—E. H. Abadie, J. F. Gerleman, E. H. Medin, L. Nahm, H. A. Wagner, G Rosenthal, E. G. Bagnall.

SYRACUSE, N. Y.:—P. T. Brady, J. L. Hinds, H. C. Hodgkins, H. D. McIntyre, A. P. Seymour.

SYCAMORE, ILL.:—J. B. Whalen.

SCHENECTADY, N. Y.:—S. D. Greene, E. W. Rice, H. P. Schuyler, C. P. Steinmetz, H C. Wirt.

STEUBENVILLE, O.:—Joseph Gwynn.

TELLURIDE, COL.:—Mr. Nunn.

TORONTO, O.:—Fred. Nicholls.

TROY, N. Y.:—E. G. Bernard.

WINDSOR, CONN.:—M. E. Baird.

WORCESTER, MASS.:—W. H. Coughlin, H. H Fairbanks.

WARREN, OHIO:—W. D. Packard, H. M. Wilson.

WHEELING, W. VA.:—E. Buchman, H. H. Dunlevy, E. M. Holliday.

WASHINGTON, D. C.:—John R. Galloway, Jas. Kennedy, Wm. McLeod, Fred. W. Royce.

LADIES.

Mrs. C. O. Baker, Jr., Mrs. C. O. Baker, Mrs. C. A. Bragg, Mrs. Bostwick, Miss Bragg, Mrs. J. N. Buckley, Mrs. J. A. Colby, Mrs. F. De Ronde, Mrs. M. J. Francisco, Mrs. U. S. Grant, Mrs. Haskins, Mrs. Hedges, Mrs. Hoag, Mrs. W. J. Johnston, Mrs. Johns, Mrs. Kietry, Mrs. J. D. McIntire, Mrs. C. H. McIntire, Mrs. A. H. Manwaring, Mrs. Millett, Mrs. Myers, Mrs. Neff, Mrs. Phipps, Mrs. W. D. Packard, Mrs. N. S. Possons, Mrs. Geo. A. Redman, Mrs. Richardson, Mrs. M. Richmond, Mrs. Seymour, Mrs. H. J. Smith, Mrs. M. J. Sullivan, Mrs. Serrill, Mrs. S. H. Short and Mrs. Young.

MAYOR ROBERT BLEE made an address of welcome, and was followed, in similar terms, by MR. JAMES M. HOYT.

MR. CHARLES F. BRUSH then made the following extemporaneous address:—

I will begin by calling your attention to the fact that dynamo-electric machines for electro-plating antedated, by a considerable period, the use of such machines for lighting purposes. This is interesting from a historical standpoint; because when I invented compound field winding for constant potential, now so generally used in lighting and power transmission, I applied it first to plating machines. That, I believe, is not generally known, and may therefore be interesting. Some of you will remember that all of the early Brush arc lighting machines were single lighters. Two of these machines were exhibited in the summer of 1877 at the Franklin Institute in Philadelphia. My two friends at the left (Messrs. Houston and Kennelly) will remember all about it. It was soon after that when we sold a single lighting machine to Dr. Longworth of Cincinnati. This was one of the very first, if not the first, sale of a Brush arc lighting machine. It was late in 1877 or the very beginning of 1878; and the Doctor paid cash for it, like a little man. I hear these things are done differently now. (Applause and laughter.) At any rate, I went down to Cincinnati to show the Doctor how to run that machine, and one evening while I was there, he exhibited the light from the balcony of the building in which he lived, on one of the principal streets. It was a 4,000 candle light and of course it attracted a large crowd of the natives, and every man in that crowd was ready and willing and anxious to tell his neighbors all about it. I mingled in the crowd for a time to hear the comments. I found one man who had collected quite an audience about him. He called attention to the solenoid at the top of the lamp. He said, "That is the can that holds the oil," and speaking of the side rod of the lamp, "That is the tube which conducts the oil from the can to the burner." He did not say anything about electricity at all—a little oversight that was not noticed by his hearers, and it was all right.

These early single light machines were quickly followed by two and four light machines; that is to say, machines adapted to furnish two or four separate, distinct currents, each adapted to run a single arc light. Several of these machines were sold during the season of 1878 for lighting stores and shops. Among others, Mr. Wanamaker of Philadelphia bought a number to light his store. One of the earliest of these four light machines was exhibited at the works of the Union Steel Screw Company in this city, to a number of invited guests. One gentleman on that occasion looked the whole apparatus over very carefully, perhaps a half hour, sized it up, and then, pointing to the line wire, he said to me, "How large is the hole in that wire that the electricity flows through?" (Laughter.) Another gentleman, one connected with the screw company, observed the machine running for perhaps five minutes in complete silence. Then he had fully digested the whole thing and was ready to tell me all about it. He said, "The electricity in that thing is generated by that revolving business, there, rubbing the air up against these iron blades (meaning the field magnets), just as you get sparks when you rub a cat's back." I raised the objection that while that was a good theory, it did not fully meet the facts, but he would not hear anything from me. He said, "The whole thing is plain. If you should run that machine in a vacuum where there is no air, you could not get any electricity." His ignorance was so blissful that I thought it would be folly to enlighten him, and did not try to do it.

The year of which I am speaking—1878—was memorable in the history of electrical lighting. It was during that year that I had the great pleasure and good fortune to invent and develop and commercially introduce, the modern series arc lamp with the

shunt coil. It was this invention—I am sure you will all agree with me—which first made arc lighting from central stations commercially possible, and I think it may justly be considered as marking the birth of the electric lighting industry of the world to-day.

One of the first instances, I think quite the first instance, of the use of arc lighting for purely commercial purposes was in our little Public Square in this city. Twelve lights were carefully installed in the park on high ornamental poles. The lamps used were of the ordinary so-called 2,000 candle power. While we were installing this plant in the Public Square a great deal of interest was manifested in the installation by the public, and on the occasion of starting the lights, our little park was packed from side to side, and it was evident that many of the people expected a blinding glare of light, as evidenced by the fact that many of them had provided themselves with colored spectacles or smoked glass. Of course, there was a general feeling of disappointment at first in this respect, although every one was ready to admit he could read with perfect ease in any part of the square. After a few weeks, when the novelty had worn off, and the people had got tired of staring at the arc and had time to see how nicely the little park was lighted, the general verdict was that those electric lights in the park were a pretty good thing after all; and that is the general verdict everywhere.

Of course, we had lots of trouble in the early days with carbons. The history of the carbon business is peculiar. Our first carbons were crooked, of course, and were soft, and had high electrical resistance, and burnt out rapidly, and were very expensive. To decrease the electrical resistance and prolong the life of the carbons, we electroplated them with copper, which is still done. This little scheme of covering the carbons with just enough and not too much copper was the only easy invention that it was my good fortune to make, and it paid fairly well, considering the effort involved, which was mighty small. It yielded, if I remember, something like $150,000 in cash on royalties before the bottom fell out of the carbon business. They were sold at the rate of $240 a thousand. I say at the rate of $240 a thousand because nobody ever thought of ordering a thousand carbons at once. They could not use them up in a generation. Fifty or a hundred was considered a fair order. As the business increased a little, we were able to reduce the price of the carbons, and we did reduce it at one step to $150 a thousand. It was at a loss for a time, but then we held our own, and afterwards made a little money. We subsequently reduced them from $150 to $62.50, on the theory that cheaper carbons would stimulate the growth of the electric light industry, and our theory was proven correct. Their use was stimulated and the business increased enormously, so that while we lost money on the carbons for a good while at that price, later we made a handsome profit at that price. Others seemed to grasp the situation about that time, and competition sprang up, and it knocked the profits of the carbon business all to pieces. I presume now you can get your carbons for next to nothing a thousand, with "a beautiful chromo in each box;" and I have no doubt if you insisted, you could get a nice gold frame for each of the chromos.

As to electrical lighting at the present day, most of you know more about it than I do, for I have been accumulating rust for several years and I will not attempt to tell you anything about it, but will simply thank you for your attention.

President Francisco then delivered an address, in which he referred to the fact that the Association celebrated its tenth anniversary in the home of Brush. He cited the statistics of the growth of the industry, stating that there are 2,500 central stations representing assets of over $300,000,000 and 7,500 isolated plants. He estimated the number of arc lights at 500,000. He stated also that there are nearly 1,000 electric railways with 10,000 miles of track and assets of $600,000,000. Mr. Francisco touched with ridicule on the municipal plant craze, spoke of the excellent condition of the Association and paid a deserved compliment to the work of Secretary Porter.

The meeting then adjourned in order that the members might be presented to Mr. Brush.

TUESDAY AFTERNOON SESSION.

The meeting was called to order at 2.30, P.M. and the first business announced was the reading of the paper by Mr. Nelson W. Perry on "The Storage of Energy Essential to Central Station Economy."[1]

The paper was discussed by Messrs. Stine, Lloyd, Seely, Nicholls and Edgar.

The paper on "A New Method of Measuring Illumination" by Prof. E. J. Houston and Mr. A. E. Kennelly, was then read by Prof. Houston, and discussed by Prof. Elihu Thomson and Messrs. Haskins, Ayer and Kennelly.

A letter of invitation from the Cleveland Electric Railway Company was read, extending to the delegates the courtesies of the street cars during their stay in the city. The Cleveland Telephone Company tendered the free use of its local and long distance lines to New York, to the delegates.

Letters and telegrams of regret at their inability to be present were read from the following gentlemen: Howard W. Sexton, Charles W. Price, Silvanus P. Thompson, Marsden J. Perry, Nikola Tesla, William McKinley, George Westinghouse, Jr. and C. A. Coffin.

The Convention then went into Executive Session.

WEDNESDAY MORNING SESSION.

The President called the meeting to order at 10.15 o'clock. The first business transacted was the reading of the report of the Finance Committee, which showed that the receipts during the fiscal year had been $5998.69, expenses $5,449.95, leaving a balance of $548.74. Mr. Seely, chairman of the Committee, reported that there were no liabilities against the Association.

The paper by Mr. W. E. Harrington on "The Correct Method of Protecting Electric Circuits,"[3] was then read.

There being no discussion on the foregoing paper, the paper by Mr. G. N. Black on "Large Arc Dynamos"[4] was then read.

The paper was discussed by Mr. S. M. Hamill, Prof. Elihu Thomson, Mr. I. R. Prentiss and Mr. Townley.

An invitation from the ladies of Cleveland, extending an invitation to the visitors and their ladies to attend the exhibition of paintings in the Garfield Building was read and duly accepted with thanks. Resolutions endorsing the Southern States Cotton Exposition were passed.

WEDNESDAY AFTERNOON SESSION.

The President called the meeting to order at 2:30 o'clock. The first business on the programme was to have been the paper on "The Monocyclic System," but, as it would take some time to rule up the diagrams necessary to illustrate the paper, the president called up the topic, "How to Light Large Cities." None of the gentlemen who were set down to discuss this topic being present, (as this was not the time announced to consider it) the president called on Mr. Wilmerding of Chicago.

Mr. Wilmerding: The cost of lighting in Chicago, according to Professor Barrett's figures of a year ago, if I remember rightly, was $96.25 per lamp. This figure, it was stated, included nothing of interest, depreciation, insurance, taxes, etc., or what in a lighting company would be called expenses. In other words, it might be said to include simply labor and material. The cost per lamp installed was something in excess of $500, which at six per cent. interest on the original investment would amount to thirty dollars per lamp, and a fair depreciation might be six per cent., which would add another $30 or a total of $60 to the cost; in other words about $156 per lamp per annum. We are furnishing a few lamps to the city at $137.50 per annum, so that as a matter of fact we are supplying lights at a lower cost to the city than they can make it themselves. On that basis it seems reasonable to suppose that large cities should be lighted by private corporations rather than by the city itself. There is no question but that in every municipal organization in this country the cost of carrying on what may be considered a commercial or private business is much greater than where it is carried on by a private corporation, where all expenses are carefully considered.

Mr. Redman, of Rochester, thought the best answer he could give to this question was to give a description of the city lighting by the two companies with which he was connected. The city of Rochester with a population of 165,000, has 2010 arc lights on the treets; 1,109 Brush, and 901 Thomson-Houston. In the centre of the city they had one street 7,940 feet in length, with no wooden poles, no overhead construction except the trolley wire. That street was lighted with 76 pair of 8-ampere lamps, on the Edison system, and gave general satisfaction. They were so popular that the cry was for lighting the entire city on that system.

The Paper on "The Monocyclic System" was then read by Dr. Louis Bell, and discussed by Messrs. Kelly, Steinmetz, Scott and Prof. Thomson.

The Reception Committee of ladies resident in the city of Cleveland tendered a banquet to the visiting ladies at The Stillman Hotel, and sent a large bank of roses to the convention hall, which was greeted with applause. On motion of Mr. Seely, a vote of thanks was tendered to the ladies of Cleveland for the reception.

WEDNESDAY EVENING SESSION.

Mr. A. J. Wurts delivered an address on "Practical Demonstrations of Protecting Lines from Lightning," which was well attended and received with much approval.

THURSDAY MORNING SESSION.

The president called the meeting to order at ten o'clock sharp, and stated that the paper of Dr. Bell was open for further discussion. Mr. W. R. Gardener responded and closed the discussion.

The president called for the report of the Committee on Data, which was read.[5]

The meeting then then went into executive session. At this session the report of the Committee on Relations between Manu-

1. See p. 201.

3. See p. 198. 4. See p. 200. 5. See p. 204.

facturing and Central Station Companies was fully considered; and the following special Committee appointed in connection therewith: Messrs. A. J. DECAMP, JOHN I. BEGGS, E. A. ARMSTRONG, T. CARPENTER SMITH, F. GILBERT.

Messrs. SEELY, ARMSTRONG and COLBURN were appointed a Committee to nominate officers for the ensuing year.

Messrs. AYER, NICHOLLS and BURLEIGH were appointed a Committee on Resolutions.

The Constitution was also amended, providing for the holding of one meeting in each year, in the months of May or June.

A motion was passed recommending that the next meeting be held in New York City.

The next business was the paper "Arc Carbons and Rating of Arc Lamps," [1] which was read by Mr. L. B. Marks and discussed at length by Messrs. PECK, AYER and ARMSTRONG.

The report of the Committee on Rules for Safe Wiring [2] was then presented.

THURSDAY AFTERNOON SESSION.

THE PRESIDENT called the meeting to order promptly at 2.30 and said that certain members desired to hear the experience of central station managers with reference to the Welsbach burner.

MR. GARDNER said that in Pittsfield there are at the present time about two hundred and fifty of these burners in use. He cited instances of their failure and general unsatisfactoriness.

MR. EDGAR said that the burner is gradually disappearing, and that his company had just completed a contract with a large store, which is going to take out the Welsbach and put in electric lights. He mentioned a letter from a drug store, stating in emphatic terms what the proprietor thought of the Welsbach. Often when his store door opens the mantle breaks from the draught of cold air.

Mr. CAIRNES said that in Memphis they became very much alarmed. The Welsbachs displaced probably fifteen hundred to two thousand lights in from thirty to sixty days, and no amount of argument could stop them. That was about a year ago. The electric company now have back from fifty to sixty per cent. of the patrons they lost by the burner, and have assurances that they will get back as much as twenty-five or thirty per cent. more within the next two months. The Welsbachs have lost ground in Memphis as rapidly as they came in favor, because the longer they are used, the more objectionable the light produced becomes; and in like proportion the greater amount of gas is consumed as the burner begins to be used.

MR. SEELY did not think the Welsbach a very serious menace to the electric light business where people are at all discriminating as to the character of light they get. In smaller towns people are not as discriminating as they are in larger cities. One of the reasons that encourage the use of the Welsbach burner is the thought that in some places the service of the electric light companies is irregular.

MR. PECK said that of 25 large stores in Brooklyn in which the Welsbach lights had been used ten have gone back to gas or incandescents.

MR. ARMSTRONG thought that electricity could not compete with gas for the small consumers. His company lost during the last quarter seventy-five customers, and did not see any cessation to it. He hoped to report by next year that the number had been diminished in accordance with the statements made from other cities.

MR. STETSON spoke of a town a little north of Boston where the manager said that if he could have seen the Welsbach burner before he bought his electric light plant he never would have troubled himself about the electric plant and is only hoping that the municipal lighting scheme would come along and buy his plant. You cannot compete with gas, the speaker continued, in small towns under twenty-five thousand inhabitants. In the larger cities electric light can hold its own. He found the greatest annoyance to come from the multiplication of the oil wagons. The Standard Oil Company has put up a very large tank holding thousands of barrels of oil, and they run out wagons just as the milk peddler does; and as our cities in the East are largely composed of people working in factories, there is no hope of trying to get anything out of them, with the electric light. If we could only increase our product we could decrease the cost; but there was no hope of this in those communities.

MR. CORRIVEAU did not think there ought to be much alarm felt about this Welsbach burner, or what they call in Montreal the oil light. Probably no city in America is provided with so many of these burners as Montreal at the present time. They have had them about a year and a half, and several thousands of them are in use; but eight or ten large stores have gone back to the electric light, and they are completely displeased with the burner on account of the breakages of the mantle and the bad color of the light.

MR. FRANCISCO said he had a customer who put in the Welsbachs and after using them a month returned to the electric light. When asked the reason, he said he had about two hundred of these burners and wanted to sell them; but did not propose to lose on his own light the profit that he made on the burners!

1. See page 198. 2. See page 193.

The Committee on Resolutions offered the following: Moved by JAMES I. AYER, Seconded by FREDERIC NICHOLLS:

"That the thanks of the Association are hereby tendered to Mrs. Sidney Short and the ladies of the local Committee; to Mr. Wason and the gentlemen of the Reception Committee; the Cleveland Telephone Company and the Long Distance Telephone Company; the Cleveland City Railway Company; the Cleveland Electric Railway Company, and the gentlemen of the local press.

The many courtesies extended to the visiting members of the Convention have been fully appreciated, and the result has been that this Cleveland meeting will be remembered as one of the most pleasant, from a social standpoint, and also one of the most interesting and instructive in the history of the Association."

The resolution was unanimously adopted.

The Committee on Nominations presented the names of the following gentlemen: President, C. H. WILMERDING, Chicago, Ill.; 1st Vice-President, FREDERIC NICHOLLS, Toronto, Canada; 2nd Vice-President, E. F. PECK, Brooklyn, N. Y.

Members of Executive Committee: E. H. DAVIS, Williamsport, Pa. (one year); W. R. GARDNER, Pittsfield, Mass.; GEORGE A. REDMAN, Rochester, N. Y.; J. J. BURLEIGH, Camden, N. J.

These names were duly balloted upon and elected.

PRESIDENT FRANCISCO then said: Gentlemen of the National Electric Light Association: In resigning my duties as president of the Association, which office I have filled during the past year, I wish to tender to the members for the sincere and generous support I have received my heartiest thanks. I have been courteously treated in all the dealings I have had with the members and been assisted in many ways, which has been duly appreciated. I expect as a private to do all that I can for the Association; and I think it is unnecessary to say that you will find me first, last and all the time assisting the central station managers in all departments. (Applause.)

MR. ARMSTRONG: I move, with the unanimous consent of the members, that the next annual meeting of this Association be held in the month of May or June, as selected by the Executive Committee in the year 1896. Carried.

The convention then adjourned.

ARC CARBONS AND THE RATING OF ARC LAMPS.

BY L. B. MARKS.[1]

The author called attention to the report adopted at the last convention of the Association, adopting as the standard 2000 c. p. arc lamp one requiring 450 watts at the lamp terminals for its maintenance, and discussed the part played by the arc carbon in relation to the dependence of the candle power upon the watts consumed. It is well-known, he said, that the so-called 2000 c. p. lamp really gives a mean candle power of from 300 to 600; that at the angle of maximum illumination ranging from 700 to 1,200. In an elaborate series of comparative tests made by the writer[2] several years ago, there was found to be a variation of over eighty per cent. in the candle power of commercial arc light carbons consuming the same energy. Quite recently, Professor W. M. Stine[3] has reported on a number of tests, the results of which show a variation of about thirty per cent.

The author showed a table giving the hissing and flaming points of various American and foreign carbons. It was shown that the difference in volts between the hissing point and the flaming point, varies greatly with different carbons; thus, while one had a range of only 11.4 volts, another had a range of 34 volts. Both of these carbons are sold by representative American manufacturers, the former being a squirted petroleum coke carbon, and the latter a moulded coke carbon. The hissing point of the cored carbon, averages over ten volts lower than the solid. The hissing point of American cored carbons does not vary much from that of the foreign, but the range of the latter is fully ten volts greater than that of the former, and exceeds that of any of the American products tested, cored and solid. The amount and nature of foreign matter in a carbon have much to do with the commercial efficiency of the latter, and determine to a large extent the range of the carbon.

The writer was of the opinion that an absolutely pure coke carbon, if such could be commercially manufactured for arc lamps, would not meet the requirements of central station practice to-day. Tests made upon carbons manufactured with special reference to purity showed that one of them hissed at 53.7 volts, and the other at 52. To be operated at maximum efficiency, these carbons would require more than 55 volts at normal current and under no conditions in practice would they give satisfactory service at less than 55 volts average—fully five volts higher than that of good commercial carbons. A test reported by Professor H. S. Carhart, in which a pair of commercial carbons designed for use on full arc circuits were used showed a maximum effici-

1. Abstract of a paper read at the 18th convention of the National Electric Light Association, Cleveland, Feb. 19-21, 1895.
2. L. B. Marks: "Life and Efficiency of Arc Light Carbons." Trans. Amer. Inst. Elec Eng'rs, vol. vii, Nos. 6 and 7, 1890.
3. W. M. Stine: "Influence of Arc Light Carbons on the Candle Power." ELEC. ENG'R, Oct. 3, 1894. See also *Elec. World*, Feb. 23, 1895.

ency at about 55 volts. These carbons at 10 amperes and 45 volts gave 450 candle power. Thus, it is of the utmost importance to the carbon manufacturer to test not only the range of his carbons, but also the voltage at which they give maximum efficiency.

It would be entirely out of the question to designate a given current density for commercial light carbons, yet in attempting to formulate a relation between candle power and energy expended in the lamp, the question of current density must necessarily be considered.

Schreihage[4] deduced the law that for homogeneous carbons of the same make the candle power varies inversely as the diameter. He states that this relation, as is to be expected, is not completely satisfied in the case of the mean horizontal candle power, especially when the carbons are very small or very large.

The cross section of the carbon, if not round, must be considered, and the constituency of the core, when one is used, has much to do with the efficiency of this type.

The comparison of the candle power of a commercial alternat-

Number.	Structure.	Diameter. (Inches.)	Basic Material.	Process of Manufacture.	Hissing Point. (Volts.)	Flaming Point. (Volts.)	Range. (Volts.)
1	Solid	½	Petroleum Coke	Molded	43.6	71.3	27.7
2	Solid	½	Petroleum Coke	Molded	48.2	79.0	30.8
3	Solid	7/16	Petroleum Coke	Molded	45.7	79.7	34.0
4	Solid	11/16	Petroleum Coke	Squirted	51.3	62.7	11.4
5	Solid	½	Petroleum Coke	Squirted	47.3	75.0	27.7
6	Solid	½	Lamp Black	Squirted	47.2	70.8	23.6
7	Solid	7/16	Lamp Black	Molded	43.0	67.3	24.3
8	Solid	7/16	Lamp Black	Squirted	43.7	76.8	33.1
9	Solid	7/16	Gas Black	Squirted	46	70.7	24.7
10	Solid	7/16	Gas Black	Molded	41.3	74.3	33.0
11	Solid	7/16	Not Ascertained	Squirted	41.7	75.3	33.6
12	Solid	7/16	Pure Coke	Molded	53.7	73.7	20.0
13	Solid	7/16	Pure Coke	Molded	52.0	71.5	19.5
14	(+), 1/16 hole (−), solid	½	Petroleum Coke	Squirted	42.8	60.7	17.9
15	(+) cored (−), solid	(+), 9/16 (−), ½	Petroleum Coke	Squirted	35.0	61.7	26.7
16	(+), cored (−), solid	½	Petroleum Coke	Squirted	31.3	58.7	27.4
17	(+), cored (−), solid	(+), ¾ (−), 7/16	Not Ascertained	Squirted	31.3	70.7	39.4
18	(+), cored (−), solid	7/16	Not Ascertained	Squirted	32.3	66.3	34.0
19	(+), cored (−), solid	(+), ½ (−), 7/16	Not Ascertained	Squirted	31.7	71.3	39.6

TABLE SHOWING THE HISSING AND FLAMING POINTS FOR DIFFERENT CARBONS.

ing current arc with that of a direct current arc consuming the same energy, as measured at the carbon points, shows that the former gives less illumination than the latter. So important is the relation of the carbon point to efficiency of the alternating current arc that the substitution of a solid carbon for a cored carbon in this form may reduce the candle power and decrease the efficiency to such an extent as to make the lamp unmarketable.

Thus far, we have discussed arcs which burn with free access of oxygen. In the case of inclosed arcs, or those which are operated in small bulbs, to which the air has very limited access, the conditions that govern the relation of watts to candle power for the open air arc are more or less modified. With inclosed arcs, purity of the carbon is very important, and in some applications of these arcs the objections which stand in the way of commercial utilization of pure carbon electrodes in open air arcs, do not apply.

The author considered that even with the best carbon product it would seem advisable to discard the term "2000 candle power" or "1200 candle power" as applied to arc lamps. Measurement of the wattage, provided for in the resolution of the Committee on the Rating of Arc Lamps, appears to be the true solution of the problem. The central station manager will undoubtedly find it to his interest to furnish good carbons, and if he demands them, the carbon manufacturer will supply them. To quote Captain William Brophy, "The sooner you sell your light as power, the sooner this trouble will end; and I advise every man in the future to sell his lamp at 450 watts, or whatever is necessary, and bury out of sight the term '2000 candle power'."

4. M. Schreihage: Centralblatt fur Elektrotechnik No. 22, 1888.

DISCUSSION.

MR. PECK: The question of carbons is exceedingly interesting to me at present, as our company is in dispute with the authorities as to the candle power of our lamps versus the candle power of lamps furnished by a competing company. I had a letter from the inspector of gas asking me to have this Association give the companies a rating on lamps burning 7/16, ½ and ⅝ inch carbons; and he also raised the question as to what is the proper size for a carbon to give a certain candle power at a given energy. I do not know whether this Association desires to put itself on record as giving standards for various sizes of carbons or not; but it seems to me the arrangement for a 2,000 candle power light as given to us at Washington really means nothing, as we find by experiment that we can get varying candle power, using that amount of energy, by using different density of carbons and different size carbons. I would like to get information from some one here who has made experiments giving the candle power by different size carbons.

MR. MARKS: In reply to Mr. Peck's question, I may say that the reference in the paper to current density partly answers his inquiry. It was stated there that within certain limits the candle power varies inversely as the diameter of the carbon; that is, on the assumption, of course, that the current be constant and the carbons be of the same batch and homogeneous. You will remember that Mr. H. Nakano, now professor of electrical engineering in the University of Japan, deduced a law for the relation of efficiency of the carbon to diameter. His results confirmed the conclusion reached by Schreihage and indicate that the radiant efficiency is almost inversely proportion to the diameter.

Thus we see that as far as the operation of arc lamps at maximum efficiency is concerned, the limitations of life of the carbon would cut a very important figure with the central station man. It is well to remember that invariably a gain in light efficiency for a given grade of carbon is accompanied by a loss of longevity of the carbon points. You all know that ordinarily a soft carbon will give you a better light than a hard one of the same diameter. If you use a hard carbon of small diameter you may obtain the same efficiency as with a soft carbon of larger diameter. Again much depends upon the character of the basic material and the binder used in the manufacture of the pencils. In the table which you have before you your attention has been called to the wide difference in the performance of commercial carbons operated under the same conditions. If you will refer to carbons numbers 6 and 7, which are made of lamp-black, you will note that the latter, which has a molded structure, acts differently from the former, which is a squirted pencil, or one made by forcing the plastic mixture through a die. These carbons, though made of the same material and carbonized in the same way, give quite different results in service, and I am quite sure if you decided that a 7/16-inch pencil of the No. 7 type gave the best results as to candle power for a given current and difference of potential, you would find that on substituting a pencil of the No. 6 type, a smaller diameter would be necessary to obtain the same light efficiency.

Again, though carbons of a certain diameter may be suitable for one purpose of illumination, a change in the character of distribution of light desired may prove them to be less suitable for another. Even if the same current be used and the same watts expended in the lamp, it would be impossible to designate a particular size of carbon to meet all cases of distribution.

When we consider that variations are apt to creep in throughout the process of carbon making, we are brought face to face with another and graver obstacle in the way of considering a standard such as proposed. Variations in the character and size of grain of the pulverized crude material; in the nature of the binders; in the constituency of the mix; in the pressure in molding or squirting, as the case may be; in the duration and temperature of carbonization, etc.; all these are more or less familiar to you and need no comment.

But, after all, why lay so much stress upon the diameter of the carbon or the candle power of the arc? Does it make any difference to us whether an arc lamp gives 500 or 1,000 candle power if the light is not available? As tersely stated by Prof. Houston the other day, what we want is a method of measuring illumination at the surface which is lighted, and not at the source of illumination. And just here comes up another point bearing on the selection of a carbon for a special purpose. A carbon arc that may be well adapted to bringing out the colors of natural objects, may fall somewhat short if the power of its illumination

as applied to black and white. For one purpose a carbon of particular structure, operated at a high voltage, may give the best results, while for another a different structure and low voltage may be required. In fact, candle power of an arc, per se, is in some respects a meaningless term, and does not give a true expression of the value of the light.

As Dr. Edward L. Nichols has shown "luminosity is the factor which we must take into account in seeking a complete expression for the efficiency of any source of illumination, and the method to be pursued in the determination of the luminosity must depend upon the *use to which the light is to be applied.* In a picture gallery, for instance, or upon the stage, the value of an illuminant increases with the temperature of the incandescent material, out of all proportion to the candle power, whereas candle power affords an excellent measure of the light to be used in a reading room."

Thus it is clear that the quality of the light as distinguished from its candle power must be carefully considered, in the selection of a carbon and in the proper operation of a lamp intended for a particular kind of illumination. You are all familiar with the preponderance of the longer wave lengths, or those at the yellow end of the spectrum, in arcs operated on direct incandescent circuits. Contrasting these arcs with the constant current series arcs, the latter show a decided richness in the shorter wave lengths, or those at the violet end of the spectrum. In the former case cored carbons are used; in the latter, solid. The analysis of the core tells the story. If time permitted I should like to dwell on various phases of the subject other than those already taken up, but I trust that what has already been said will cover the scope of Mr. Peck's inquiry.

Prof. B. Thomas, gave the results of some of his experiments. The carbons upon which measurements were made consisted of ten or more pairs of carbons, obtained from nearly all the central stations in the state of Ohio. The point of the investigation was to determine how much variation there is in the candle power afforded by arcs which are maintained at an expenditure of a constant amount in watts.

The watts that we made use of in the investigation were a little higher than the rating adopted by this Association, namely, about 500 watts, as nearly as we could judge. Our machinery was adjusted so as to work steadiest at ten amperes, and with the arc length we find commonly maintained in lamps in Columbus, we found that sometimes 51 to 52 volts was required to maintain the arc in that condition. I will give the results at 45 degrees, which has been found is about the angle at which the most light is produced. I find in the case of the first make of carbons tabulated that at 45 degrees the candle power measured ranges between 1,855 and 1,422. The variation in the candle power of this make shows 23.3, with a variation of 3 per cent. in watts. The candle power relation is widely different from the relation of watts. Second make, similar data, candle power 886 to 1,429; variation in candle power 38 per cent., 2 per cent. variation in watts. The next make, 556 candle power, 7 per cent. variation in watts.

The next make of carbons gives a variation of 39.8 per cent.; 2.2 per cent. watt variation. Next, candle power 2,048 to 1,370; 33 per cent. variation in candle power, for 2.3 per cent. variation in watts. Next, 40.3 per cent. in candle power, one-half of 1 per cent. in watts. Next, 45 per cent. variation in candle power with 3-5 per cent. variation in watts. Next, 26 per cent. variation in candle power, with 2.8 per cent. variation in watts. Next, 44.7 variation in candle power, 3 per cent. in watts.

The foregoing will answer in part the question which was partly answered by Mr. Marks as to the influence of size, etc., whether the carbons are coated or uncoated. The average candle power of all makes with uncoated carbons, 1,677; coated carbons, 1,474, half inch size; $\frac{7}{16}$ inch uncoated, 1,611 C. P.; coated, 1,459. In both these cases the smaller carbon has the smaller candle power. Of course, this is not to be taken as conclusive, because the point of investigation was not to determine the influence of size; and I should say from a scientific point of view there are many points left out of this investigation.

I think the watt rating is simply taking a step in one direction which does not tend in any degree to remove the trouble which you all experience, and you are simply changing the ground, that is all. My idea as to what should be done I have privately urged for some time. It is substantially that set out in Messrs. Houston and Kennelly's paper, read at this meeting, that the proper basis for a contract between a municipality and a corporation, is the illumination that is produced upon the street. There will then be no question of arc lamps, candle powers, or anything of that sort.

The speaker criticised the illuminometer of Prof. Houston and Mr. Kennelly as an instrument of precision, believing it to be unreliable owing to the fact that the human eye varies so greatly in sensitiveness in different individuals.

Mr. Ayer and Mr. Armstrong did not agree with the last speaker that in rating the arc lamp by wattage no progress had been made. For lack of a better standard it did well enough at present as it gave at least some basis to work on.

Mr. Marks called attention to a test in which the carbons, tested for mean hemispherical candle power, showed 456 and 486 candle power, respectively. On being tested for efficiency they showed 11.71 and 10.01 per cent., respectively. The efficiency referred to here is the radiant efficiency or ratio of luminosity to total radiation. The current in each test was nine amperes and the P. D. forty-five volts. One of the carbons was a squirted coke carbon, the other a molded. It would be noted that the carbon showing the higher candle power had lesser efficiency. It seemed quite probable that in this case the difference in the quality of light explained the discrepancy.

LARGE ARC DYNAMOS.[1]

BY CHAS. N. BLACK.

Glancing back over the past 15 years and noting the rapid progress made in all branches of electrical engineering, it appears strange that arc dynamos have met with so few changes. The general tendency now, however, seems to be toward larger units and lower speeds; but, although the increase in size has, of course, increased the efficiency to some extent, we still notice the massive field magnets with their enormous amount of copper and the small armature, which alone is enough to account for the inefficiency of these dynamos. Another noteworthy fact is that, with one exception, which perhaps I need not mention, all the new machines thus far described are of what is known as the closed coil type. This is the more remarkable when we consider that fully 75 per cent of the arc lights in this country run from open coil dynamos. The open coil dynamo at the very earliest date appealed to such men as Charles F. Brush and Elihu Thomson as being especially suited for this constant current work, and by the remarkable genius of these pioneers, was so perfected, that to-day machines with scarcely a single alteration from the design of 15 years ago are being sold in competition with the latest closed coil dynamos.

The speaker then described the main points of difference between the open coil and the closed coil type of machine.

It is in the commutator and commutation, he continued, that we find the most marked difference between the open and closed coil arc dynamos, and herein, lies the great superiority of the former over the latter. Take for example, a new open coil 125 lighter,[2] and one of the latest closed coil 100 light machines. In the one there are 24 segments in the commutator, while in the other there are 160. To go into details as to which is the easiest to insulate and keep in repair is scarcely necessary before a society of practical managers and engineers.

Some advocates of the closed coil dynamo, however, claim that such a small number of commutator segments causes a discontinuity in the current, and consequently, a greater strain upon the insulation of the line. This is not a new objection to the open coil dynamo, and has been answered long ago. It seems, however, to have been revived recently, and I have noticed that one builder of closed coil apparatus, lays great stress upon the fact that its machine generates an absolutely steady current, and therefore, puts no undue stress upon the insulation of the line.

The author then referred to the well known experiments of Mr. Mordey in England in 1887, showing absolutely no fluctuation of current in a Brush machine from 2,000 to 100 volts.

A much more vital question in connection with these large units delivering current to the line at the enormous E. M. F. of 6,000 volts or more, is this: What value will the E. M. F. attain in case the circuit is suddenly broken? From a theoretical standpoint, basing our deductions on the manner in which the two types commutate, the open coil machine has largely the advantage. Opening the circuit is the same, in one sense, as suddenly throwing a high resistance into the line; and when we do this we shift the point of commutation back under the brush, owing to the reaction of the armature current being reduced. Consequently, the bobbin, which should not be cut until after its segment has passed from under the brush, short circuits the one in parallel with it, and as a result the segment connected with this bobbin carries the arc around to the opposite brush, thereby causing the machine to flash; this short circuits the armature, and the E. M. F. drops to zero. This flash is not due to the insulation breaking down at any point, but is simply drawing the arc of a short circuited bobbin part way round the commutator, and in this way is acting like a safety valve. The machine is not injured in any way, and as soon as the break in the circuit is repaired it is ready to again deliver current to the line.

Knowing that some tests on underground circuits would be of interest to central station engineers, I arranged through the courtesy of Mr. E. A. Leslie, of the Manhattan Electric Light Co. in New York, to make some determinations as to the rise in voltage, when a long underground circuit was suddenly broken. A Brush open coil 125 light machine was connected to a twelve mile underground circuit, supplying current to 125 arc lamps. The voltmeter registered 6,850 volts, at the machine terminals. The circuit was then broken a number of times with the carbon

1. Abstract of a paper read at the 18th Convention of the National Electric Light Association, at Cleveland.

2. See The Electrical Engineer, Feb. 20, 1895, page 154.

point in shunt with the break. At first, the carbons were separated by a distance, corresponding to 10,000 volts, and this distance was then gradually reduced until the current jumped the air space. This, indicated only 5,000 volts. The carbons were then set for 6,000 volts; with the result that the current jumped twice in breaking the circuit eight times, showing that we had about reached the limit. It was then decided to try breaking the circuit near the center. Under these conditions, 5,000 volts was the highest reading we obtained, but there was a marked difference in the time of discharge. In the first case, there were two discharges in rapid succession within a half second after the break, while in the second case fully two seconds elapsed before the current jumped. In both cases there were two discharges before the arc was established, the first one being short and snappy, resembling a static spark. From this it will be seen that the capacity of the circuit more than counter balanced any rise in voltage due to self-induction of the machine and line. With these results before us we can safely assume that the insulation of a cable will not be overstrained by an accidental break in the line. All these considerations led the Company with which I have the honor to be connected to adhere to this, the open coil, type of machine in designing their large units.[3]

The characteristic curve of this machine without any regulator, the readings being all taken at the sparkless position of commutation, is almost perpendicular, and is probably the nearest approach to that of a constant current machine ever attained. By winding more wire on the armature, we could have made this machine deliver a constant current of 9.6 amperes at all loads, without shunting any of the current from the field; but this would have increased the internal resistance and also have made the machine much less efficient at light loads. By the present method of regulation, we reduced the C^2R loss at ¼ load from 4,018 to 3,367 watts, or in other words, we gain almost one electrical horse-power. The curve of the electrical efficiency at full load reaches 94 per cent., which is accounted for by the liberal allowance of iron in the armature, thus reducing the reluctance of the magnetic circuit, and by the large size of the wire used on both field and armature.

The curve of the commercial efficiency is over 90 per cent., and approaches very closely the efficiency of incandescent dynamos of equal capacity, but the most noteworthy point is the high efficiency at ¼ load.

The curve of the machine separately excited, with no current in the armature, indicates a new departure in arc dynamo design, namely, that the magnetic circuit is not worked at nearly as high a point of saturation as in the old types.

DISCUSSION.

MR. S. M. HAMILL, of Cleveland, in discussing Mr. Black's paper, spoke of the economy of space and efficiency effected by the use of a few large machines instead of many small ones. The field, he said, as far as manufacturers are concerned at the present time, is almost entirely along the line of exchanges from the small to the large units, and there is very little profit in it for the manufacturer.

PROFESSOR THOMSON said that, considered purely as an electrical affair without reference to the practical uses, there could be no question but that the closed circuit dynamo is the better electrical structure, but that in practice there may be considerations which will modify that conclusion. When I first entered the business, he said, my object was to get that kind of a machine which, put into the hands of men of no experience with machines of the kind, could be run successfully and keep the lights going, and the object was to reduce to the utmost simplicity those parts which were subject to wear and which could be injured by bad handling. Therefore the commutator was reduced to very few parts, and it was constructed so that if anything happened to it, to injure the segments, it was a simple thing to take off the segments and put on others. The fact that an arc dynamo, when it has its circuit interrupted, will not give the rise of voltage which the continuous dynamo gives, has been known for a long time. The point of flashing was admirably brought out in the paper. The moment you begin to open the circuit of a machine it is the same thing as overloading, that is, you are putting in a high resistance. The arc that follows amounts to so many arcs put in resistance. The potential, on account of the self-induction of the wire coils, at once begins to rise with the attempt to hold a diminished current. If at that moment the commutator, owing to its arrangement and construction, flashes over, or arcs across from one side to another, you have removed the E. M. F. of the armature, and if the machine, as is often the case, has a copper band in the field poles, then we have an inductive circuit parallel with the field winding which takes out the inductive E. M. F. from the field coils, and it is not surprising that there should not be a great rise in a case of this kind. Long ago the natural practice was that when we ruptured the circuit of the open coil, the flashing did not extend any great distance, but it was a well known fact if you had a closed coil the circuit of flash was much longer.

MR. TOWNLEY agreed with Mr. Hamill that the pressure is very strong for large units for arc lighting, and spoke in favor of the alternating current. With the introduction of the alternating lamp, he said, and the ability to run power from apparatus of this character, there is a great point to be gained in large cities, particularly where underground work is necessary, when we can supply incandescent and arc lighting and power from the same unit; and if that unit be a large unit, we can take advantage of the best economy in steam practice and higher efficiency in dynamo construction. It seems to me, he said, that development is bound to be in future along the lines of these larger units and that as the electric lighting public, men who have their money and interests involved in this industry, come to know that this system is a profitable one, successful commercially, and acceptable to municipalities, it is bound to be a very prominent factor in our interests hereafter.

MR. PRENTISS said that the question of line insulation with the use of larger units seemed to be one of care more than anything else. He spoke of several instances where large machines were put on ordinary circuits. Very little trouble was experienced, and the underground work which had been started for high potential did very nicely. The only trouble which would be practically met would be from the point of the line into the place where the light would be used, in the connecting appliances. The trouble principally arises from the moisture getting down into the cut-out box. He believed that very few cut-out boxes would stand the ordinary high potentials of 3,000 volts for three or four days of wet weather. He did not doubt that existing lines of two or three thousand volts could be made to run at a high potential. It had been demonstrated in several instances to be practical.

MR. SMITH told of a case where fifteen 10-lighters were put in series on an 18-ampere current. He thought that was as much of a strain as would be experienced with any of the large machines being advocated. The old machines were repeatedly speeded up to give nearly the same capacity. 40- and 60-light machines were running, he said, on 86- and 90-light circuits, and the extreme case was probably reached in New York city a few years ago during the time the wires were being put underground, when in one station they ran two sixties and a thirty in series.

MR. PRENTISS added that a practical demonstration of what can be done, is that in New York City the two 40-light machines run on an underground circuit.

THE STORAGE OF ENERGY ESSENTIAL TO ECONOMY OF WORKING IN CENTRAL STATIONS.[1]

BY N. W. PERRY, E. M.

When we consider how enormously short the results of actual practice in lighting stations are of those which are obtainable under the most favorable conditions with the same machinery, it behooves us to inquire into the cause of this deficiency and to see how far we can remedy it.

Professor Kennedy has made some very careful tests to indicate the effect of variable load upon coal consumption. Dividing the day into three portions, he determined the fuel consumption, the feed water evaporated and the indicated and electric horse-power developed during each period in an English lighting station. During the periods of light load the fuel consumption per horse-power is very large.

The author then shows by Prof. Unwin's figures that with engines working on a very regular load, the total annual cost per electric horse-power is $48.68, while with engines working with variable load under conditions similar to those of an electric light station the total annual cost per electric horse-power is $117.78.

The author then discussed at considerable length the annual cost per horse-power with storage batteries, gas storage and gas engines, the Halpin "thermal storage" system, steam storage, the "feed storage" system, and the combined feed and steam storage system. The results obtained by the author in the case of a station having a mean load 25% of its maximum are given in the following table.

	COST PER YEAR OF 1 ELEC. H. P.		SAVING EFFECTED.	
	Coal $1.75 per ton.	Coal, $3.50.	Coal, $1.75.	Coal, $3.50.
Present method, steady load	$48.68	$65.62	......	.....
" Gas Engine	88.28	108.61	$29.50	44.79
Combined Feed and Steam Storage	94.42	111.35	23.36	37.05
Feed Storage	97.58	117.58	20.20	30.82
Without Storage, Load factor 25%	117.78	148.40	......	......
Steam Storage	117.84	134.77	−00.06	+13.63
Complete Battery Storage	131.21	161.74	−13.43	−13.34

In conclusion the author states that, of all the methods of storage available, the storage battery would, on theoretical grounds, be the best because of its forming the last link in the chain, thereby giving the economics of continuous working to all that precede.

1. Abstract of a paper read before the N. E. L. A., Cleveland, Feb. 19-21, 1895.

Unfortunately, it involves such large losses in itself as to nearly if not quite nullify the advantages it would otherwise present. And again, its extreme cost above all other methods renders it unavailable in any complete storage project. We are therefore compelled to go back of the engine for our equalization schemes and put up with the losses due to variable load upon all that follows. Fortunately the losses which we can overcome at this early stage are quite considerable, and we have a number of methods at hand. Of these the gas engine—involving a gas storage—seems to give the best results. Very closely following this comes Halpin's combined feed and steam storage, followed by feed storage and steam storage.

DISCUSSION.

Prof. W. M. Stine:—It is well known that Europe has far excelled America in the development and applications of the storage battery. This has not been due entirely to apathy manifested in this country towards the storage battery, but rather to positive prejudice. But a change seems to be occurring. There is no longer a question but that the use of storage batteries will effect a considerable saving under proper conditions, provided the storage battery employed be reliable. At this stage, if the expectations based on the storage battery be too high, disappointment will result and a good thing again rejected with contempt. For this reason prospective purchasers of a battery should be put in possession of needed caution and should be well aware of their faults in order to properly estimate their virtues. Lack of proper knowledge of the subject can be assigned against many makers, inventors and supporters of this form of apparatus. More practical knowledge of storage batteries has always been bought at a high price. There is scarcely another class of electrical apparatus which involves so many intricacies and where the chances for success or failure are decided by such small margins. A storage battery plant, when it fails, fails so completely and involves such a relatively great expense, that it would seem only thoroughly competent men should be employed in their development and applications. An accumulator plant must be intelligently and judiciously cared for. Its efficiency at best is low, and should the charge or discharge be continued too long the total efficiency is greatly lowered. The accumulator is not automatic in its action in the same sense that a transformer is and requires constant inspection and testing, and supervision as well, when in action. The saving which it will effect at the coal pile is offset by the price paid for an attendant and this factor must not be overlooked when estimating its economy. The cost of attendance is relatively high for small plants. Many people seem to think a battery can be left to take care of itself on discharge, but when the economy of the plant is more important than its convenience, this is not possible. The speaker then called attention to the nature and extent of the attendance required.

An accumulator differs from the dynamo or engine in rate-efficiency of working, a dynamo being most efficient when working near its rated capacity. The accumulator is not; the lower the rate of charge and discharge, within certain limits, the higher will be the efficiency. Trade competition has led to a large over-rating of cells. The ordinary 300 ampere-hour cell will show the best results and most economical life if worked to only 75 per cent. of its rated capacity. European experience has shown that it is possible to reach an efficiency in watts of 75 or 80 per cent. At present a good cell should show an ampere efficiency of at least 90 per cent. These are certainly good results, but would seem capable of improvement.

At present it seems as if central station managers would not install a storage battery plant unless the life of the plate be guaranteed by the maker. This seems to be an unfair demand, unless the manager in turn guarantee the quality and extent of the attention to be given to the plant. A good cell may be ruined by injudicious as well as careless treatment, and the margin between proper care and unfair treatment is so narrow that such questions would involve endless complexity and litigation. It is only fair to the manufacturer that he guarantees his cell to be fairly uniform as regards capacity and efficiency, and the question of life be left with the purchaser, unless poor construction become evident in the life of the battery.

The author then discussed the chemical actions which go on in storage batteries, and the methods of testing to ascertain their condition.

The considerations in selecting a battery for central station or power may in part be summed up as: 1. Plenty of lead in the elements. One maker places the quantity at 2 ampere hours capacity per pound. 2. Ample storage capacity for the work to be exacted from the battery; this should rather be over-estimated. 3. The plates should be well separated, and easy of access for cleaning. 4. The mechanical strength of the plates should be able to withstand all charging strains. 5. The plates should be free from all soldered joints and the metal should be homogeneous. 6. The plates should be free from points that may be especially weakened by local action. 7. The active material should be so disposed that it may have the freest possible access to the acid. 8. The active material should be so thoroughly attached to the plates that it will not readily fall off in use. 9. The separate plates of an element should be so attached to the connecting bars that they may be readily removed for inspection or repair.

The speaker also drew attention to the necessity of using a pure electrolyte and concluded by saying that with proper measuring instruments and auxiliary devices, pure electrolyte, good plates, and intelligent care, a storage battery plant is undoubtedly a paying investment, and a source of marked economy in operating a central station.

Mr. Herbert Lloyd: The author gives the total investment without storage battery as $306.80 per horse-power. The first error is in assuming that all the energy generated is stored. He assumes a loss of 25 per cent. of all the energy generated but as only half is stored, the loss should be but 12½ per cent. of the whole. Instead of dividing by .75 he should have divided by .875, which gives the total cost of the machinery as $155.42 instead of $181.80.

Next as to cost of buildings: Taking the buildings at $30, as in previous cases, buildings without battery would cost $58.04. Adding 25 per cent. to this, which is very liberal, for battery building, we get $68.30 or a total of $228.72 instead of $306.80.

Next comes the cost of electric storage battery which is given at $35 per horse-power erected, or $420 for 12 horse-power hours which would be necessary if the plant was half direct and half storage. Where such figures could be obtained I am at a loss to understand. About 50 per cent. has been added to the real cost. A battery plant can be erected to-day for $24 a horse-power hour, which would give a total investment for a plant half storage of $228.72 plus $288, or a total of $511.72 instead of $726.80 as given. It would be readily seen how the decreased interest charge will affect the final result.

Next as to maintenance of storage battery. Ten per cent. on the total investment of a central station battery plant is unheard of. Ten per cent. on the price of the lead plates is the highest maintenance contract which has come to my attention, and this would about correspond to 6 per cent. on the first cost of installation. So, instead of 10 per cent. on $420, as a maintenance cost, we have but 6 per cent on $288 as an actual fact.

Again, in estimating the amount of coal consumed per electritrical horse-power, Mr. Perry gives for steady work, a coal consumption of 2.21 pounds. If charging batteries does not give regular load, I would like to know what does, and yet he gives the coal consumption for charging batteries at 4 pounds.

By substituting corrected battery figure for those quoted by Mr. Perry, we have the following results:

BATTERIES AT $24 PER ELECTRICAL HORSE POWER HOUR.

Coal at $1.75 per ton	
Steady load without electrical storage battery	$48.63
Variable load made steady by battery	83.19
Variable load without battery	117.76
Saving with electric storage battery	$34.59
Coal at $3.50 per ton	
Steady load without electric storage battery	$65.62
Variable load made steady with battery	100.12
Variable load without battery	148.41
Saving with electric storage battery	$48.29

Mr. Perry's figure of $52.31 with steady load without storage battery is evidently an error in figuring as it should be $65.62 as I have stated. To sum, comparing the results of the various systems, we have the following:

	Coal at $1.75	*Coal at $3.50*
Storage battery	$34.59	$48.29
Gas engine	29.50	44.79
Feed and Steam Storage	23 36	37.05
Feed Storage	20.20	30.83
Steam Storage	00 06	13.63

It will be seen that correcting the battery figures has changed the result from –13.48 and –13.34 to a saving of $34.59 and $48.29, respectively. I would state that the figures given on gas engine methods are in my opinion far too favorable to the gas engine for central station work when based upon results obtained in this country. The units are necessarily small and the speed comparatively high, making the cost of labor, maintenance and depreciation much higher than would be the case were large steam engines and generators are used running at slow speed.

By correcting the figures on the first cost of battery, and the figures that I have given cannot be disputed, the situation acquires a new aspect. Instead of the application of a storage battery resulting in the loss of over $13 per annum per horse-power, we have a saving far above that shown by any other system, in fact, about 50 per cent. greater than the saving shown for combined feed and steam storage. The Edison Illuminating Company of New York are just installing a battery of nearly 2000 horse power hour capacity and it is mainly upon this contract that the figures given above are based. In the exhibition room over in the hotel, one of the cells about to be installed is on view, which has a capacity of 400 ampere hours, having a discharge rate of 1000 amperes for between three and four hours.

Mr. Perry touches very lightly on the great utility of the battery to be discharged in from one to three hours as applied to

taking the peak of the evening load. I learned from many large station managers that 1½ to 2 hour battery is what they most need, and when it is borne in mind that a battery of this character costs to install about $50 per horse power, the situation acquires entirely new aspects. A direct plant including boilers, engines and dynamos of the most improved durable machinery will certainly cost from $60 to $75 per horse power and I think the fact that storage batteries can be installed worked at 1½ to 2 hour rate for about $50 per horse power, certainly brings the electric storage to the front. Mr. Perry is mistaken when he states that at rapid discharge rate the battery is less efficient than 75 per cent. This can be readily proved and is being demonstrated every day. Not only is the first cost of storage battery brought within the reach of central station operators, but the depreciation can be kept down as low or lower than the depreciation of any other machinery which can be installed. Those of you who were in Washington a year ago will probably remember a description read of the central station battery installed in Germantown, Philadelphia the previous year. I am glad to be able to state that that battery have been in constant and successful operation ever since and up to date has not cost the station nor the battery manufacturing company one dollar for repairs.

In the room can be found a paper describing a more recent installation of a battery in the city of Merrill, Wisconsin, where it was applied to both railway aud lighting circuits. This battery has a capacity of about 325 horse power hours and its effect as a regulator both on the light and power circuits are very strikingly shown on the diagram attached. I may also state that the cost of this battery is covered by the figures quoted above.

As the Germantown battery, the Merrill battery and the one about to be installed for the New York Edison Company cover all the central station batteries which have been as yet contracted for, with the exception of a foreign battery installation in Boston, the prices obtained for these different plants are the only ones on which estimates can be reliably based. Any one taking the trouble to have asked for information from the manufacturers would have been afforded every facility for obtaining the exact and reliable figures.

Mr. Seely referred to a storage battery installation of 600 cells, the annual cost of maintenance of which was 28 per cent. on the investment. This was in 1885. Mr. Lloyd remarked that the fact that 600 cells were required showed the character of the installation, as the same work could now be done with 60 cells.

Mr. Wright: The Germantown Battery was put into regular service on February 4, 1894. It supplies current to the 220 volt, three wire, direct current mains furnishing electrical energy for incandescent light and power. It is in operation from dawn to dusk of every day. It has been in continuous use from the last mentioned date until the date of writing, with the exception of July 29th, when the entire battery was dismantled and a complete set of new wooden separators put in.

The Germantown battery is put into charge during the evening after the load has dropped somewhat and when fully charged, which is done in from five to seven hours, is allowed to stand until the engine is stopped in the morning. The battery is then put into circuit and feeds the line until dusk, when the engine is started again. In this Germantown case, however, the conditions were such that the day circuit when run by steam power was costly from the very fact that the output was so small. Now that the battery takes the day circuit, although the output has increased at least 25 per cent. it does not now average over 50 amperes. Careful hourly readings of E. M. F. current and specific gravity have been taken on this battery from the time of starting up.

These figures show that up to the time of changing the separators February 2d, to July 27th, or nearly six months, the watt efficiency was 82.6 per cent. These figures include the first charge for which some allowance ought of course to be made. The figures from July 30th to October 7th inclusive, over two months, give the watt efficiency 74.2 per cent.; ampere efficiency, 88.6 per cent. These latter figures represent the true efficiency, and are very much better than the writer expected. He allowed 30 per cent. less when estimating results prior to the installation of this battery.

The writer has again gone over the figures relative to the saving accomplished by the use of this battery. You will remember that before installing the first small battery at Germantown these were made to find the actual cost of operating day circuit by steam power. It was found that the operation of the day circuit cost $3,615.15 per annum. The saving by the use of the battery is made up as follows:

One man at $10.00 per week	$520.00
½ man at $7.50 per week	195.00
(This man now spends half his time trimming arc lamps.)	
Fuel, 582 Tons at $1.85	1,076.70
Water, 300 M. at 60 cts	180.00
Oil, Waste and Sundries	100.00
Depreciation and repair on plant now idle, valued at $8,000 at 5 per cent.	400.00
	$2,471.70
Less Depreciation, Battery, *(est.)	600.00
Net saving	$1,871.70

Besides the above we hope to be able to put the battery to help out the dynamos during the night run. Tests have been made recently to ascertain to what extent this can be done.

Mr. Nicholls: I would like to say that so far as the Germantown system is concerned at that time, it appeared to me that the day load, which is such an important feature in the use of the storage battery, was practically negligible. So far as I am aware, the only two practicable systems in central stations in this country are in New York and Boston, respectively. I believe Mr. Edgar of the Boston Edison Company is present, and I am sure we would like to hear from him.

Mr. Perry: I was not able to catch specifically all of the criticisms that were made as to my figures. The statement is made that I have charged too much for the depreciation of storage batteries, which is put at 10 per cent., and too much for the batteries. As to the cost, Unwin puts it at £8 per horse power hour storage capacity, or $40. Prof. Forbes puts the figures at about the same for English practice. I thought I was safe in putting it at $35. In regard to my charges for energy lost, I have put it at 25 per cent. With twelve horse power hours stored, 25 per cent. of that would be lost if the efficiency of the battery were 75 per cent. That I have charged and nothing more. I have distinctly stated further along, where we apply it to a station and change the character of our load line, that the amount lost is only that part of the energy stored in the battery at that time and has no reference whatever to the other units working below it. The figures stated by me are less than those given by the Electric Storage Battery Company.

Mr. Edgar: We have been operating for the past year one of the largest storage batteries in the world. I think that I can answer a number of the arguments made in the paper, but not having seen it until the reading, cannot do it in detail. We pay for a 400 horse power battery 6 per cent. on the cost of the cell, which is about 4 per cent. on the cost on the installation, and for a ten years' guarantee. (Applause.) As the result of putting in the first battery a year ago we are now putting in one double the size, so that we own to-day the largest in the world. The original battery was put in after a personal investigation abroad, and I do not see how anyone can go abroad and look at the batteries that are used there and have any hesitation whatever in putting in a battery, if you get a guarantee. It has never entered my head in the slightest degree as to whether a battery was economical.

The only question which has come up has been, Can you get a battery which will not deteriorate? We are saving ten per cent. of our coal bill by a battery costing per horse power one-half as much as our steam plant. We have in one of our stations four 600 horse power engines. Our maximum load, purely Edison three-wire system, lasts for 1½ hours. I asked for specifications for a battery which would run 600 horse power one hour and a half. Having nothing to go by for American practice, I asked for a battery to duplicate one of our steam engines. A first-class steam plant costs $100 a horse power, everything inside of the building. That is being done to-day. That battery cost us a little over $50 a horse power to do the maximum work. We did not want it to do it for twelve hours. That would be the point Mr. Perry speaks of. We did not need it. We bought it for service during one hour and a half. Looking at it on that basis, we can save fifty per cent., or half of the money, by putting it into batteries; so that our total investment in the station, with half batteries and half steam, is only three-quarters of what it would be all steam. We bought the battery to take care of the maximum load, and have never used it for anything but the maximum load, and we still save twenty-five per cent. This is all assuming that the battery will be made to work, and you can get a guarantee. We succeeded in getting a ten years' guarantee from a firm absolutely reliable, one of the old firms in Germany; for 6 per cent. on the cost of the cells, not the switch-board or copper bars, they will take care of it. Up to the present time they have not spent a cent. That does not mean much, because it has only been running a year. The operation has been in the hands of a German, whom they sent here, who gets twelve or fifteen dollars a week. The discharge is only for one hour and a half.

Mr. Perry: Your case would come under the supposition that I have referred to in the latter part of my paper, where you would take the peak of the load—you do not attempt complete storage. I have separated the two. If they were stored for twelve hours and run for twelve hours the cost would be doubled or trebled.

Mr. Edgar: Those conditions do not exist. I take the conditions as they exist in business. I do not know any condition such as you have shown in the electric lighting business.

Mr. Perry: The result would be as I have shown—too expensive.

Mr. Edgar: That would be running a battery with a steam annex, instead of vice versa. There are no stations running currents such as you have referred to. Your load curve is incorrect.

Lowell, Mass.—There is a movement on foot to start a new telephone company in this city. Prominent men are said to be interested in it.

REPORT OF THE N. E. L. A. COMMITTEE ON DATA.[1]

The information contained in the tabulated report submitted herewith while recording data from fewer places than usual is believed to contain correct information and more than usual detail. Certain classes of equipment are not reported in sufficient number to warrant correct averages, but every central station manager will find in the table a style of equipment sufficiently like his own to enable him to compare results with at least a few others who are similarly equipped. The table contains reports from twenty-four stations using coal as fuel. The highest economy is shown in report No. 22, where 262 watts are generated from one pound of coal, the plant furnishing nearly 23,000,000 watts during 24 hours, the equipment being triple expansion engines with dynamo on the engine shaft, and horizontal water tube boilers with heaters, without economizers, the firing being done by hand. This result is secured from one-half each soft coal and hard screenings. An examination of this report proves it to be a high average for twenty-four hours, as with an evaporation of 9.37 lbs. of water per lb. of combustible, and a water consumption of 17 lbs. per horse power, allowing 10 per cent. non-combustible in the coal, and taking the efficiency of the generators as stated at 85 per cent., we have $\frac{9.37 \times .90}{17} \times 746 \times .85 = 314$ watts produced from one pound of coal. This average is much nearer the theoretical efficiency of a modern steam plant than any report previously received by this committee.

Taking an average of the ten reports from stations generating over 5,000,000 watts in 24 hours we have 147.5 watts per lb. of coal, or a production of one electrical horse power for four lbs. of coal on a basis of the efficiency of the generating machinery as stated in the last report by this committee.

Previous reports by this committee have been criticised as inaccurate and incomplete, and an attempt has been made in the work here submitted to improve it in both these particulars. From the first, the results of this work have been handicapped by reports from the central stations incorrect, incomplete, and based upon a variety of testing instruments constructed without any absolutely uniform standard. And again many central station managers do not wish to have their work made public, and in order to get at the results secured by these people, the information has previously been furnished to the committee, through your secretary, in such a manner that the committee were relieved of the responsibility of the exact source of the information furnished. This, in a measure, defeats the main object of the work.

A careful review of this work for the past three years reassures this committee that the present method of securing data from central stations by individual effort on the part of the committeemen, with the understanding that the information is to be held confidental, meets all the requirements, as any manager can communicate with the author of any report either through the committee or the Secretary of this Association, and reports can be had in this way from many who are not as willing to have their work made public as is our friend from Atlanta. Several members of the present committee were unable to give the matter attention and the table is therefore made from a limited number of reports. If the succeeding committee could pledge its membership to secure at least twenty-five reports each from the central station managers in their locality, a much more valuable report can be made. We submit what has been done, trusting that it may prove useful and that it may be elaborated and improved if found of sufficient value to central station managers to warrant their more complete and careful co operation.

	EQUIPMENT.						PRODUCTION.														FUEL.		
	ENGINES.		BOILERS.		DYNAMOS.		ARC CIRCUIT				INCANDESCENT.				POWER.								
No. of Report.	Class.	Water Consumption per H. P.	Class.	Evaporation per Pound of Combustible		Efficiency	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Readings Every Min.	Total Watts from all Circuits.	Whole Amount of Coal Used in One Day.	Watts Produced per Lb. of Coal.	Kind and Grade of Fuel.
22	A	17	A	9 37	Multipolar	85					7670	124.9	24	22 967.952					30	22,967 952	87.358	262	½ Soft Coal, ½ Hard Screenings.
1	B&F		C&D		Con & Bipol.		10	8145	24	1.954.800	224	1140	24	6,128,630	50	500	13	325,000	60	8,408 440	46.700	180	Hocking Screenings.
9	B		C		Multi. Alt. &c.		10	2387	13	5,896,081			24	2,434,500		500		2,322,750		10,653 331	59,884	177	Run of Mines, Alabama.
15	F		C		Arc, Alt.		6.8	47	4	1.278	66 4	1010	15	67,064						997,238	5.460	182	George's Creek, Cumberland.
8	E	27¼	C		Alt. & Com		10	1000	12	120,000	37	1100	13	529,100					15	649,100	3,700	175	Cumberland.
18	BX FX	32.7	C	11 3	Alt & Con.		6.7	7000	8	355,144	7 05	1172	24	1,983,024	42.4 80 3 65 2	1142 325 548 2	23¼ 10 16½	1,125,765 260,170 589,743	15	4,313,846	24 750	174	Pennsylvania Soft Coal
12	B		B	8.4	Arc		9 5	48	14	10,552,752										10,552,752	62,000	170	Soft Coal
2	BEZ	15 5	A		Various		9½	4800	12	6,600,000	150	2200	24	7,920,000		250 525	24 18	908 200 400,000	10	15,878,250	50 tons	158	Slack and Nut.
16	E		C		Arc, Alt		by	Meter		246,000				580,000				948,000		1,774,000		150	Pocahontas, Soft
13	CX	24	C	10.5	Various.		6.8	2275	14	7,042,426										7,042,426	50,238	140	Babylon Pea
10	B F	23 6	B	11 34	Alt., Bipolar		9.8	50	12	1,817,256	137	1130	24	3 715,200	36	535	24	465 000	30	5,997,456	45,000	133	Illinois Washed Pea
21	CX		A C		Alt., Bipolar.		6 8			779,051	37	--	16½	837,930			10½	190,000	30	2,806,981	21,203	132	George's Creek, Cumberland.
17	B E		C		Alt., Bipolar.		6 8		7	357,000	40	1200	14	672,000					60	1,029,000	8,000	128.6	Coaldale, Bituminous.
19	F		C		Alt.		6.8	1100	5¼	43,010	27	1100	7½	Meter 224,400					60	267,410	2,200	121	Pocahontas, Cumberland
3	A Y	18	C	8.8	Alt., Bipolar.		10	Meter.	24	1,990,000		Meter.	24	90,900			24	950,000		3,849,000	35,322	108	Michigan Run of Mines, Poor.
20	F		C	9 02	Various.		6 8	6500	8⅓	367.333	100	240	16	384,000						845.333	8,131	104	Cumberland and Hard Scr'ngs.
14	A				Various						6000	116	24						15	16,704,000	164,000	100	Buckwheat, No. 1 and 2.
4			A		Various		10	3472	24	833,250	339	117 5	24	3,[illegible]3,600	23	1060	24	534,640	15	5,241,500	60,283	86	Illinois Lump and Nut.
7	F		C	7 68	Alt		6 8	1150	7¼	56,840	24	1040	7¼	105,560					30	162,400	1,963	83	Second Youg'y, Nut.
6	F		C		Alt		6 8	656¼	8	35,700	16 75	2000	8	268 000	.5	3916	6 5	127,269	30	530,996	6,583	80	Indiana Slack
5	G X		A		Con. & Mult						180	116 6	24	2,016,000						2,016,000	25,600	78	Illinois Nut
11							10	50		1,500,000	104 140	120 1100	24 24	3,700,000 299,000	32	550	14	509,850		6,008,850	86,750	69	Soft Slack
23	B E X		A								160	1000	16	1,640,000					30	1,640,000	42,000	44	Indiana Block.
24	F		C	6 3	Various		10	50 ea	12	1,104,250	112	1120	12	1,505,280	15	223 9	18	181,035	30	2,790,565	79,800 11,900	30	Bituminous Pea. Bituminous Slack.

EQUIPMENT.

CLASS A. Boiler Room Horizontal Water-tube boilers; feed through heaters by steam or power pump, hand firing. Engine Room: Triple Expansion Condensing Engines. Dynamo on Engine Shaft.

CLASS B. Boilers Vertical Water-tube, economizers feed as A. Hand firing. Engines, Corliss Compound Condensing, belted to jack shaft.

CLASS C. Boilers, Horizontal Tubular, feed as A. Engines, Simple Corliss or slow speed, condensing, belted to jack.

CLASS D. Boilers, Upright Tubular, feed as A. Engines, Simple Corliss, Non-condensing.

CLASS E. Engine, High Speed Compound Condensing, belted direct.

CLASS F. Engines High Speed Simple Non-condensing, belted direct.

CLASS G. Engines High speed Compound Non-condensing.

REF. X. Any of the above non condensing.

REF. Y. Belted to dynamo.

REF. Z. Dynamo on the Engine shaft.

TABLE ACCOMPANYING REPORT OF THE N. E. L. A. COMMITTEE ON DATA.

DISCUSSION.

MR. W. R. GARDNER considered a paper of this kind of very great importance to station managers, and suggested that the valuable work of this committee be extended so as to give other items that enter into the cost of developing energy, aside from that of coal. Mr. Gardner then read the result of a test carried on under his direction, as follows:

METHOD OF OPERATION: The entire coal used during period of test was weighed, including that used for banking. The water was also weighed.

The number of watt hours produced was found by ammeter and voltmeter readings taken as follows:—

Single phase alternating current, readings every 30 minutes: watt hours produced............... 1,983,024.

2 phase alternating current, readings every 15 minutes: watt hours produced.................. 1,125,765.

Street Railroad, readings every 10 minutes: watt hours produced............................ 589,743.

1. Abstract of Report presented at the Cleveland Meeting, Feb. 19-21, 1895.

Arc lights, readings every 15 minutes: watt hours produced	855,144.
800 volt direct current power, readings every 15 minutes: watt hours produced	260,170.
Total watt hours produced	4,812,846.

NO. OF HOURS EACH CLASS OR SERVICE WAS RENDERED.

Single phase alternating current from 8 A. M. Dec. 27th to 8 A. M. Dec. 28th, total run	24 hours.
2 phase alternating current from 8 A. M. Dec. 27th to 12.15 M., and from 1 P. M. Dec. 27th to 8 A. M. Dec. 28th, total run	23¼ hrs.
Street Railroad from 8 A. M. Dec. 27th to 10.30 P. M. and from 6 A. M. to 8 A. M, Dec. 28th, total run	16½ hrs.
Arc lights were run from 3 45 P. M. Dec. 27th to 6 30 A. M. Dec. 28th, total run	14¾ hrs.
800 volts direct current power from 8 A. M. Dec. 27th to 6 P. M., and from 7 A. M. to 8 A. M. Dec. 28th, total hours run	10

My object was to find out the ratio of the different items of expense to the whole. The different items entering into the cost of developing energy I will class as follows:—

First, which I will call *cost of steam* (coal and water only).

Second, which I will call *cost at throttle of engine*:—The above and wages of firemen, repairs of boilers, interest on boiler room investment, fire and boiler insurance on same, depreciation on boilers which I have allowed at 5%.

Third, which I will call *cost at the switchboard*:—The above and wages of engineers, dynamo tenders, mechanic and wiper, repairs electric plant, oil and waste, interest on steam plant, interest on electric plant, interest on real estate, insurance on entire building and contents.

Fourth, which I will call *cost at the lamp or motor without depreciation*:—The above and general salaries, office expenses, cost of carbons, globes, insurance, interest, incidental expenses, incandescent lamps, law expenses, oil and waste, repairs steam, repairs electric, repairs lines, taxes, wages wiring and wiring supplies.

Fifth, which I will call *cost at the lamp or motor including depreciation*:—On total investment (which I have placed at 5%. This does not include drop in the lines from station to lamp or motor.)

Taking the fifth, *cost at the lamp or motor including depreciation*, as the total cost, I find that the cost of steam is 33.8% of the whole:

That the cost at throttle of engine is 6.8% more or 40.6% of the whole:

That the *cost at the switchboard* is 26.4% more or 67% of the whole:

That the *cost at lamp or motor without depreciation* is 15.7% more or 82.7% of the whole:

That the *cost at the lamp or motor including depreciation* on investment, but not including any drop in line, is 17.3% more or 100%, the original total cost.

I should have been very glad to give you exact figures in dollars and cents. I have arranged it on the percentage basis. You will see by this report that the item of coal and water represents one-third of the entire cost of developing energy at the station, and I presume that this is the case with most of the stations situated at a distance from the coal supply. If this is the case, how important it is that we should know the best kind of coal for us to buy, as most of you are probably aware the price of coal is no sure indication of its value as a water evaporator.

The importance and practical value of these reports was dwelt upon at length. MR. BARKER, chairman of the Massachusetts Electric Light and Gas Committee, praised the work highly and said that it was a credit to the committee that compiled it.

MR. AYER presented the following resolution: "That the Committee on Data be directed to send out as soon as possible after the adjournment of this meeting, blanks upon which records of central station, may be kept, with full instructions how to make the returns."

The resolution was carried, and a vote of thanks was tendered to the committee.

CONVENTION EPISODES.

WHILE the recent inclemency of the weather did much to lessen the attendance of ladies, there was a good muster of at least a score. They were rewarded for their bravery by a splendid reception at the hands of a Ladies Reception Committee, the indefatigable and altogether perfect "chairman" of which was Mrs. S. H. Short. Luncheons, visits to art galleries, excursions, dinners and theatre parties made up a round of pleasure that made one wonder what Cleveland could be like in its favorite June if these were its delights in dismal midwinter. However, the ladies survived both the weather and the ceaseless round of charming amusement; and it is to be devoutly hoped that Mrs. Short and her associates feel in some degree repaid by the enthusiastic admiration they received from the entire convention, which has never known a Reception Committee acquit itself more nobly.

THE NEW YORK CONVENTION TRAIN organized by Mr. C. O. Baker was as usual a brilliant success. Mr. Baker may be said to own an electrotype from which each year he takes a new impression, so unvarying is the skill, success and smoothness of his arrangements. The train reached Cleveland on Monday night with nearly 120 delegates and ladies on board, and despite the length of the run and the bad weather was very near its schedule time. The main Chicago contingent arrived early on Tuesday morning, nearly 70 strong, while the nearness to that city enabled many other Chicagoans to run over during the week.

CONVENTION NOTES.

THE OHIO STORAGE BATTERY CO., of Cleveland, were represented by Mr. George A. Washburn, their factory manager, who showed samples of their battery plates. The Ohio Co. are about to equip several very large mansions in the vicinity of Cleveland with their batteries for illuminating purposes, and are now making a specialty of that class of lighting work.

J. J. RENEHAN, of New Britain, Conn., showed a neat model of a mast arm for suspending arc lamps in the middle of the street. This mast arm embodies some excellent new features, the lamp being lowered at the side of the mast, instead of the centre of the street, and the operation of pulling the lamp from the point of suspension to the mast and the lowering of the lamp to the ground, being accomplished by means of an ingenious arrangement by a single drum.

THE CLEVELAND ELECTRIC ILLUMINATING CO. threw open their new station to all comers, and everybody made a trip of inspection. The station was described and illustrated in THE ELECTRICAL ENGINEER of Feb. 20. It contains many features of interest, not the least being those that concern the peculiar location of the plant and the means adopted to offset the disadvantages. The lofty smokestack is a landmark, and can be seen from almost every point of view.

THE CHICAGO CROSS ARM CO. were represented by Messrs. H. M. Angle and Chas. S. Marshall, who also exhibited the Ericsson telephone apparatus, which is quite prominent in Sweden, and is said to contain many novel features. They distributed also a copy of a report made by the U. S. Department of Agriculture on the relative strength of white and yellow pine, the latter only being used for their cross arms on account of having 40% more strength and possessing at least 35% more life.

THE CHLORIDE ACCUMULATOR CO., represented by Mr. Lloyd, had a neat exhibit in the Hotel basement of one of their large cells, so that everybody was able to study the construction of the plate and the manner of securing the pastilles in the lead. The cell attracted considerable attention, which was in nowise lessened by the lively discussion in the convention over the merits of storage in central station work. A general feeling of satisfaction was expressed at the manner in which the Company had harmonized conflicting interests and relieved purchasers of worry about litigation and infringements.

THE JEWELL BELTING CO., of Hartford, Conn., were represented as in former years by Mr. C. E. Newton and Mr. C. L. Tolles, who showed an interesting model for demonstrating the value of their new pulley covering. They showed two pulleys mounted on a pedestal, one of which was made of plain brass and the other covered by the Jewell pulley covering. By means of a belt and weights this showed conclusively that with their covering, 25 per cent more "grip" can easily be obtained. Samples of their regular Jewell dynamo belt were also shown, and it is interesting to note that the Jewell Belting Co. never had more orders for large dynamo belts than they have at this moment. Mr. Newton and Mr. Tolles had also a few handsome pocket money flaps which they distributed among their friends.

CLEVELAND STREET RAILWAYS.—Thanks to the practical thoughtfulness of Mr. A. W. Wason, chairman of the Reception and Entertainment Committee, all the members registering with the Secretary were provided with books of street car tickets good on any line. This courtesy was highly appreciated. Several of the street railway power houses were visited and Mr. Wason had ready a very neat and handy little memorandum pamphlet giving the details of all the work in the East Cleveland power house of his company—the Cleveland "Big Consolidated." Mr. Wason's natural aptitudes as an engineer have had an excellent opportunity for gratification in the growth of the electric railway industry, his own power houses exemplifying the evolution of current generation in a very interesting manner. The members enjoyed their visits to the power houses very much, and many of them learned "a thing or two" from their street railway brethren.

PARANITE WIRE was kept prominently before the convention, a neat souvenir in the shape of Prof. Roberts' wiring slide rule being distributed by the agents, the Cleveland Electrical Mfg. Co.

MR. EDMUND DICKEY, of the American Carbon Co., Dayton, was everywhere extolling the merits of their carbons, claiming to be able to suit all systems and all currents.

THE TRIUMPH DYNAMOS had an able champion in their Mr. J. C. Hobart who showed all interested why the "Triumph" is so good at such a low price.

THE CUMMINGS AND ENGLEMAN CONDUIT Co. of Detroit sent their inventor, Mr. Jas. Cummings, who in an interesting manner explained the good points of his conduit.

THE COMMERCIAL ELECTRIC Co. through their Mr. Hadley kept the merits of their latest multipolar generators prominently before the many visitors.

MR. WM. H. BOSWORTH, Pres. of the Parkin & Bosworth Company, Cleveland, was a daily visitor, looking after the interests of the Shultz Belting Co. of St. Louis.

THE STANDARD UNDERGROUND CABLE Co. occupied parlors 236 and 237 where visitors always found a hearty welcome. The company was well represented by Messrs. J.W. Marsh, Vice Pres., of Pittsburg, G. L. Wiley, New York Eastern manager, J. R. Wiley, Chicago, Western manager, and electrician H. W. Fisher of the Pittsburgh office.

THE COLUMBIA INCANDESCENT LAMP Co., of St. Louis, Mo., had their ever popular agent, Mr. C. I. Hills, looking after their interests. He was ready at all times to discuss the incandescent lamp situation, and the peculiar merits of the Columbia lamp. The number of regrets expressed at Mr. Rhotehamel's absence simply could not be counted.

MR. J. J. GATES, of Perkins switch fame, made quite a sensation during the last two days of the convention by having a wheel-barrow pushed around by a small boy dressed up in gayly colored clothes for the occasion, which bore a colossal picture of the Gibbs switch, and was seen by everyone within range of vision.

MR. FRED ROYCE, of Washington, of course was present as usual to see all his old friends and make many new ones. Business is a secondary object with Mr. Royce on these occasions, but a convention without him would certainly be incomplete, and business, honors and pleasures of all kinds are simply thrust upon him.

PASS & SEYMOUR, of Syracuse, N. Y., were represented as in former years by Mr. A. P. Seymour, who had no samples with him but met many of his warm friends, and talked over old times. Pass & Seymour goods require no description and can be procured anywhere, and Mr. Seymour does not come to sell, but simply to talk and take the opportunity of showing the latest developments in his branch of the business.

THE HILL CLUTCH Co. had headquarters in parlor No. 114 where by means of a series of excellent photographs, the good points of the Hill clutch were kept prominently before the visitors. Tuesday night a very pleasant reception was given in their parlor, and the occasion will be long remembered as a most enjoyable one. Mr. S. S. Leonard, a pioneer central station man, now prominently identified with them, was in constant attendance.

THE INTERIOR CONDUIT Co., of New York exhibited the new multipolar slowspeed Lundell generators in connection with the exhibit of the Central Electric Co. of Chicago. The Company entertained in their parlor every evening, and were always surrounded by a representative gathering, showing not only the popularity of their specialties but of the representatives of the company.

THE INTERIOR TELEPHONE Co. (Colvin system) were represented by their president Mr. F. R. Colvin, who was on hand for the purpose of looking after the interests of his company. Mr. Colvin reports more than 300 buildings throughout the United States now equipped with his system, some of these buildings having as many as one hundred telephones. The company is represented throughout the United States by no fewer than 25 agents, quite a number of whom were present at the Convention.

THE HART & HEGEMAN MFG. Co., of Hartford, had Mr. Hart himself on the ground looking after the multifarions interests of his company, being later joined by Mr. G. S. Searing, their Chicago representative. They had no exhibit, the Hart switch being so well known, but found many interested enquirers for their goods. Mr. Pease, the treasurer of the company, was conspicuous by his absence, but some one had to stay at home to attend to their large business.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., had their old representative Mr. P. C. Ackerman on the ground, accompanied by Mr. F. E. Donohoe, both of whom gave good accounts of the vast interests now represented by their company. The American Electrical Works are now drawing all their own wire, and are beholden to no one but the miners of copper for the basis of their product. They have thus been enabled to build up an immense business, being able to compete with any in the market.

THE JENNEY ELECTRIC MOTOR Co. Indianapolis were represented by President Chas. D. Jenney, who invited all interested to inspect one of their new type multipolar generators in operation at the factory of the W. S. Tyler Wire Works.

MR. M. B. AUSTIN, Western selling agent for the Safety Insulated Wire and Cable Co. and for Holmes, Booth & Haydens, was among the Chicago delegation and distributed the "Safety" puzzle and "K. K." watch protector.

S. F. B. MORSE of Chicago, representing Kerite wires and cables, did not have any exhibit, but circulated around the hotel with his pockets full of samples of their many good things, which he distributed among his numerous friends.

THE SWAN LAMP MFG. Co., of Cleveland, O., with headquarters in the same parlor with the Brush Co. were represented by Mr. S. E. Cox, T. A. Boardman, Jr., J. M. Strong, and E. L. Nash, who exhibited a number of their regular Swan incandescent lamps, in various styles and sizes, arranged very prettily in the shape of a swan, symbolic of the name of the company.

THE AMERICAN ENGINE Co. distributed a descriptive circular of their high grade dynamo electric machinery, the manufacture of which they have recently engaged in. Mr. O. P. Loomis is their treasurer and electrician, and his many years experience in designing machinery of that kind would seem to be a guarantee of good results.

PRES. GEO. A. MCKINLOCK of the Central Electric Co. arrived the second day and assisted by Messrs. Chas. G. Burton and P. B. Chaney took excellent care of the company's many friends and customers. The several specialties handled by this company, such as Okonite, Interior Conduit, Lundell dynamos and motors, Helios arc lamps, etc., have been so widely advertised and are now so well known as to make any detailed mention unnecessary.

MORRIS & MAC CURDY, of Indianapolis, were represented by Mr. Elmer P. Morris, whom everyone knows, and who was kept extremely busy showing the virtues possessed by their new Phœnix rubber insulating paint. Mr. Morris exhibited a common pipe coated with this paint which, when held in the flame of a torch (giving out 2,800 degrees of heat) showed no deterioration. An ordinary wooden magnet spool wound with cotton covered wire was also shown covered with the paint, and this also, when subjected to the heat, came out with the magnet wire unharmed. Many other tests were shown, of the absolute fireproof qualities of the paint, and all went to prove that Mr. Morris has an article which all electrical engineers will wish to investigate for themselves. They did a rushing business at the Convention and it looks as if they would be busy for some time filling orders.

THE MANHATTAN GENERAL CONSTRUCTION Co, of New York were represented by S. Marsh Young and G. W. Wise, who showed the Manhattan incandescent arc lamp in operation, and the Manhattan dynamo brush. This lamp burns from 100 to 200 hours with a single pair of carbons, which are enclosed in a small globe, placed inside of the usual large globe. The lamp burns singly on any constant potential circuit, from 90 to 130 volts, instead of two in series, as is the case with all other incandescent arcs. The outer globe being air tight is a perfect guarantee against any danger from sparks, and is thus particularly adapted for use in stores, where the goods are of a highly inflammable nature. The lamp is highly endorsed by the underwriters. This feature of the lamp in the summertime, serves also to keep the globes free from moths and other insects. The dynamo brush is of flexible woven wire gauze, and is of the same high grade as they have uniformly supplied. The Manhattan Co. are also general Eastern agents for the well known Buckeye incandescent lamp.

THE BUCKEYE ELECTRIC Co., of Cleveland, O., had the honor of having the prettiest and most tastefully arranged exhibit at the Convention. In one of the large parlors they had erected a white pyramid broadening from three feet at the top to 20 feet at the bottom, on which were mounted 5808 incandescent lamps of 16 candle power. In a corner of the room was erected a smaller pyramid, on which were mounted examples of all the lamps which the Buckeye Co. manufacture, varying from 10 to 100 candle power, and of all shades and colors. On the table were shown about 75 varieties of different kinds of incandescent lamps, showing conclusively that the Buckeye Co. are equipped to manufacture every conceivable kind and variety of incandescent lamp used at the present day. An extremely handsome "Buck's-head" was also exhibited, the points of the antlers being tipped with vari-colored lamps illuminated. A tray was also shown bearing all the details showing the process of manufacture from the unbaked carbon filament to the finished lamp. The exhibit was in charge of Mr. George R. Lean, and the company was represented by Messrs. J. Potter, C. H. Rockwell, Arnold Spiller, J. R. Massey, and Bailey Whipple, the last of whom is about to open an office in Atlanta for Southern trade.

THE BETHLEHEM IRON CO. were ably represented by Mr. Albert Fisher, of Fisher and Porter, the Western sales agents.

THE VULCAN TORCH could be seen in constant operation in the basement, Mr. H. R. Smith never tiring of explaining its many points of merit.

MR. J. E. WAY, Gen'l Agent for R. Thomas & Sons Co, was busy taking care of the many users of their porcelain goods. The Messrs. Grier Bros. represent them in the West.

MR. EDWARD LASELL, Chicago, arrived early Tuesday morning and was kept busy talking up incandescent lamps and telephone material.

MR. LUTHER STIERINGER, the consulting engineer, rarely misses a convention, his object in attending being not only to renew acquaintance but to watch the drift of things.

E. G. BERNARD & CO., of Troy, were represented by Mr. E. G. Bernard, who distributed a currency folder and some literature relative to their specialties, such as the Adams dynamo, the Powers arc light cut out, new porcelain cleat, etc.

THE SWEET ELECTRIC & MFG. CO. through their vice-president and electrician, Mr. Sam'l Barnes, showed samples of the Sweet limit switches of which over 4,000 have been sold since last June.

THE CROUSE-TREMAINE CARBON CO.'s interests were looked after by the well known pioneer, President J. B. Crouse. Sec'y Tremaine was also in attendance, while their Chicago representative Mr. Harry S. Hart took good care of the Western visitors.

JNO. A. ROEBLING'S SONS CO. had a neat sample board in parlor 101. Mr. A. B. Connover, Jr., of the Chicago office was in attendance. Mr. H. L. Shippy was also present from New York headquarters.

ACME INSULATING PAINT made a splendid showing with its pyramid of sample cans. The Paragon Insulating Co. of Cleveland are putting this new article on the market. Messrs. Frank Abbott and E. B. Merriam were in attendance.

THE BROOKLYN ELECTRIC MFG. CO.'s exhibit of quick break Baehr switches, from 25 to 600 amperes capacity attracted marked attention. They also showed their new quick break midget switch, which is intended to take the place of the old style snap switches. Mr. Louis Wintner was in charge.

HERRICK & BURKE, the new firm of electrical engineers, made their convention debut, and received the encouragement of a great many friends. Mr. Herrick's work on switchboard design has made him well known, while he and Mr. Burke have already won considerable reputation in the line of designing stations and special machines. The firm already have some new work in hand, and expect plenty more as times improve.

THE STANDARD PAINT CO., of New York, were represented as of yore by Mr. Frank S. De Ronde, Mr. J. C. Shainwald, and William Weierbach. Mr. De Ronde distributed to his numerous friends a handsome souvenir in the shape of a Mexican grass card case, and though he did not have any exhibit, P. & B. being so well known as to require none, yet he imparted to those interested, much valuable information regarding the valuable qualities of his products.

THE CUTTER ELECTRICAL MFG. CO. of Philadelphia had Mr. H. B. Cutter and Mr. W. E. Harrington at the Hollenden House, to explain the merits of their specialties. They showed a sample of their magnetic circuit breakers for railway and power switch boards, dynamo and motor circuits, also a sample of their 500 volt protector terminal fuse cut-out, and a full line of flush switches. They also exhibited their magnetic cut outs for trolley car protection, and many other devices of excellent design and substantial workmanship.

THE HOLTZER-CABOT ELECTRIC CO., of Boston, were represented by Mr. C. W. Holtzer and H. E. Hall, and showed samples of their direct current fan motors, series alternating motor, and the new 1895 non-synchronous alternating motor without commutator or brushes. This new motor will start up to full speed in 8 seconds, when it will be in perfect synchronism, and automatically cuts out the starting coils. When in full operation it runs perfectly noiselessly, and is a fan motor which will fill a long felt want, being absolutely reliable. Having no brushes, there is nothing to get out of repair.

THE BRUSH ELECTRIC CO., of Cleveland, O., had parlor No. 1 in the Hollenden House and were represented by Messrs. S. M. Hamill, L. N. Rogers, W. S. Rogers, A. H. Hough, I. R. Prentiss A. D. Dorman and T. E. Adams. On the centre table they exhibited the first arc light dynamo built by the Brush Co., in 1876, which now possesses considerable historic interest. They also showed a few samples of the regular Brush-Adams arc lamp, series and constant potential, in plain and ornamental style. Naturally, from the fact that the Brush works are situated in Cleveland, their chief exhibit consisted of their dynamos operated and in course of construction at the works, and a special car, fitted with Sperry apparatus and Sperry electric brake, was placed at the service of all visiting delegates for transit to the factory, many of whom took advantage of the opportunity.

THE PRENTISS CLOCK IMPROVEMENT CO. showed one of their new mechanical self-winding clocks. This is quite a novelty in the way of self-winding clock mechanisms, the principal feature being that the pendulum-actuating spring is kept under practically constant tension.

MESSRS. KITTLE AND MACE of the Interior Conduit and Insulation Co. contributed not a little towards making the company's many friends and visitors feel comfortable. The Company were also represented by general manager Little and director Bakewell, and issued a superb souvenir number of the *Architects' Electrical Bulletin*, giving handsome pictures of some 50 or 60 new buildings in which the Interior Conduit system has been installed, within the last year or two. The buildings were, of course, but a mere handful out of the whole vast number thus wired, and were selected for their beauty or prominence.

THE CARPENTER ENAMEL RHEOSTAT CO., of Hoboken, N. J, were represented by Mr. C. E. Carpenter, and Mr. H Ward Leonard, who showed samples of their various styles of rheostats and heating devices. Their device for automatically cutting resistance into motor circuits, should the power be cut off, attracted considerable attention. Mr. Leonard also showed a soldering iron which readily melted solder with ½ ampere current and 110 volts, consuming only about 50 watts energy. Chafing dishes, flat irons, etc., were also shown being heated electrically and with great efficiency.

THE NEW BRUSH ARC DYNAMO was put under frequent and severe test at the Brush works for the benefit of successive parties of visitors. The machines experimented with were of the 100 and 125-light size. In the latter case as many as 125 and 135 lights were thrown on and off at once, as well as in batches of ten or twenty; while the machine was short circuited with the utmost recklessness. Under the condition of a dead short circuit the current would only run up from 9.6 to about 11.5 amp. Other features of the machines were described by Mr. Black in his paper, and will also be found set forth in the article on the Brush works in THE ELECTRICAL ENGINEER of Feb. 20.

THE WESTINGHOUSE ELECTRIC AND MFG. CO. had engaged one of the parlors on the ground floor near the main entrance, where they had a beautifully arranged display board filled with samples of the several styles of Westinghouse stopper incandescent lamps. A special feature of this lamp exhibit consisted of different styles and shapes of ornamental lamps, giving a most pleasing appearance. Current had been furnished through the courtesy of the Cleveland Electric Illuminating Company. Another attractive portion of their exhibit consisted of the Wurts non-arcing lightning arresters. By the use of a Holtz machine these arresters where shown in as nearly actual operation as is possible by artificial means. The different experiments performed attracted marked attention not only from the electrical fraternity but also from a large number of laymen. The company's interests were well looked after by Messrs. Alex. J. Wurts, Chas. F. Scott, Ben. Lamme, F. S. Smith, H. P. Davis, H. D. Shutte and R. D. Mershon, of the technical staff; Messrs. Calvert Townley, G. H. Lewars, G. B. Dusinberre and J. C. Hubner taking care of the commercial side, assisted by Messrs. E. N. Sanderson, manager Boston Office, C. A. Bragg, manager Philadelphia Office, H. L. Cragin of the New York Office and E. H. Heinrichs, the advertising manager.

THE GENERAL ELECTRIC CO. had at the Cleveland Co.'s station the exhibit of the "Monocyclic" plant of which full details were given in the last issue of THE ELECTRICAL ENGINEER. This system has also been fully described in these pages. There was also a fine display of lighting supplies; the porcelain specialties—switches, cut-outs, etc., manufactured by the General Electric Company at its own works; a complete line of punched clip station switches, primary alternating, railway, power, and direct current two wire and three wire recording wattmeters, several of which were in operation, an arc watt meter and a Thomson portable ammeter. In addition a supply of the new General Electric key sockets with porcelain bases was shown and one was bestowed as a souvenir on each of the visiting delegates. The exhibit was rounded off by a handsome specimen of railway switch board work, the controlling instruments being mounted on a fine panel of Tennessee marble, and by a 12 inch search light projector. Visitors were taken to the exhibit in conveyances furnished by the company. At the Hollenden the Company occupied the banquet room as headquarters. The representatives of the General Electric Company were Prof. Elihu Thomson, and Messrs. S. D. Greene, E. W. Rice, Jr., Charles P. Steinmetz, Dr. Louis Bell, J. R Lovejoy, B. E. Sunny, W. L. R. Emmet, A. D. Page, Wilson S. Howell, C. D. Haskins, H. C. Wirt, under whose special care the exhibit was installed; W. F. Hays, T. Beran, F. M. Kimball, C. E. Harthan, G. F. Rosenthal, L. D. Tandy, Edgar Mix, and Messrs. Bostwick, Benbow and Greenwood.

THE CHICAGO GENERAL FIXTURE Co. had a fine display in the basement.

PRESIDENT KING, of the King Bridge Co. Cleveland was a frequent visitor at the Hollenden as well as in the Convention hall.

McINTIRE CONNECTORS, probably the most popular means of making a joint to-day, were talked up by Mr. McIntire himself, if indeed any "talking up" were necessary.

MR. S. M. HAMILL, of the Brush Electric Co., laid many friends under additional obligations by his unfailing and unremitted courtesies of all kinds.

MR. ALLEN C. BAKEWELL, interested in the Interior Conduit and Insulation Company, could be found in the company's parlors shaking hands with a host of satisfied patrons of Interior Conduit and Lundell apparatus.

THE FAMILIAR FACE OF N. S. POSSONS, was welcomed by all, especially by those who like himself have helped to bring up the arc lighting business from a puny infant to the Hercules of to-day. His Universal Electric Co. is soon to be heard from.

BAKER & Co. the well known firm of gold, silver and platinum refiners were of course represented by Mr. C. O. Baker, Jr. whose interesting pamphlet of data concerning platinum, etc. was appreciated by all interested.

THE THOMSON-HOUSTON CARBON Co. were represented as of yore by Mr. D. R. Urquhart, than whom no one knows more about the development of the carbon business, or the best methods of disposing of the product.

KING INSULATING MATERIAL was brought prominently before the convention by means of a nicely arranged sample board. It is something new and is claimed to possess superior insulating qualities.

THE STIRLING BOILER exhibit of magnificent photographs of their numerous installations made a good showing in one of the upper halls. Messrs. Pell, Stettinius, Wehrly and Bruce made a strong combination in the company's interests.

THE ABENDROTH & ROOT MFG. Co. were represented by P. L. McLaren from New York. Their improved Root water tube boiler has come to the front again lately in a remarkable way, in power house and central station practice, and their list of new plants for railway and lighting work is growing rapidly.

T. H. BRADY, of New Britain, Ct. attended the Convention and looked after all interested in the development of mast arms. Mr. Brady is the pioneer in this line of business, and what he does not know about mast arms may be neglected without serious detriment to one's knowledge of the subject.

THE NATIONAL CONDUIT Co. of New York, were represented by Mr. J. P. McQuaide, C. Gallagher, and H. F. Tate, who discoursed ably on the value of their system of conduit for placing cables underground. Last year they laid about seven million feet of conduit, and have now on order over a million feet. Is any further comment necessary?

GENERAL W. S. ROGERS, of Cleveland, long connected with the interests of the Brush Co., made himself particularly agreeable to all the delegates, and amply sustained his reputation of being one of the most popular electric promoters in the field. Mr. Rogers has installed a great many Brush plants, and looks as if he would succeed in installing many more, if popularity and personal enterprise and push will accomplish it.

THE BROWN HOISTING Co. of Cleveland were represented by President Brown, who was perhaps a little surprised to learn how well electrical men were acquainted with the really marvelous exploits of his apparatus for hoisting and conveying ore, earth, etc. as for instance at the Cleveland docks and on the Chicago Drainage Canal. His Company has recently acquired the Yale & Towne electric crane interests, and will hereafter give great attention to that class of work.

THE BERNSTEIN ELECTRIC Co. of Boston, were represented by Mr. Henry B. Cram, who did not have any particular exhibit but who had lots of interesting information to impart on the subject of the manufacture of incandescent lamps to those interested. The Bernstein lamps are well and favorably known all over the country, and their quality is still maintained at the high point of excellence for which they have always been noted. Mr. Cram's one idea is "Quality."

THE EDDY ELECTRIC MANUFACTURING Co. of Windsor, Ct., had Mr. M. E. Baird on the ground to look after their interests, and tell interesting stories of the success of the Eddy motors and generators. Mr. A. D. Newton could not get away from Windsor this year, and was much missed, but Mr. Baird ably took upon himself the pleasure of entertaining all their mutual friends and as would be naturally expected, succeeded in sustaining his reputation for a genial good fellow, and an able exponent of the necessities of good dynamo construction. The Eddy company are one of the oldest companies in the field, and maintain steadily their reputation for first class work and successful equipments.

THE STANLEY ELECTRIC MFG. Co. of Pittsfield, Mass., were well represented by Messrs. H. Hine and J. F. Kelly. Their "exhibit" is described elsewhere in this issue.

THE PETTINGELL ANDREWS Co. of Boston, had Mr. E. B. Kittle in attendance to look after their interests, more especially with regard to the Lundell motors, for which they are agents. Mr. Kittle seemed to be everywhere and to know everyone, and evidently found many listeners to his remarks on the value of the Lundell motor and dynamo. The Pettingell Andrews Co., through the efforts of Mr. Kittle, are working up quite a large business in this line, in addition to their regular line of electrical supplies.

THE OKONITE Co. of New York, had a parlor in the Hollenden House, presided over by Mr. W. L. Candee and Mr. G. T. Manson, in which a few samples of the ever popular Okonite wires and cables could be seen. The name of Okonite is synonymous with good material, and the names of Candee and Manson are so well known that it is needless to say anything further about them. They know everyone, everyone knows them, they have good goods and they get good business.

THE NATIONAL CARBON Co. were to the fore all the time, and were represented by Messrs. Laurence, Miles, Hayes, Hackenburg, Burns, Smith and others of the home staff or the branch offices. It is needless to say that many if not all the delegates visited the new factory and lost themselves both in its vastness and in admiration of the enterprise and ingenuity of which they saw evidence on every hand. Carbon is still a "king" in the electrical business, and there is not a single province of its domain for which the National Carbon do not furnish some of the material used.

THE WASHINGTON CARBON Co. of Pittsburgh, were represented by Messrs. J. S. Humbird, J. S. Crider, A. H. Mustard, and L. W. Washington, who were kept quite busy exhibiting samples of their new Helios cored carbons, which they put on the market about the first of this year, and which have already attained a great success. They have other carbons for sale also, but the the demand for the Helios is increasing every day. It has evidently filled a place long vacant, and now everyone wants to try them. They are well worth a trial.

THE ELECTRIC ENGINEERING AND SUPPLY Co., of Syracuse, in addition to a most complete line of their well-known switches and porcelain specialties, exhibited an elegant marble central station switchboard, encased in a handsome cast brass, polished frame. The switches used are their new special switchboard type, have fuse connections, enclosed in fibre tubes mounted with them. The board was arranged for two dynamo and three line circuits and elicited much praise from all observers. Messrs. J. D. McIntyre, J. L. Hinds and H. C. Hodgkins were in attendance.

THE W. S. HILL ELECTRIC Co., of Boston, were represented by Mr. C. H. Herrick, who had with him one or two blades of the well known Hill switch, which he showed to any who where anxious to see really first-class work. The style and finish of these switches is second to none in this country, and many will remember the magnificent exhibit of large switches they showed last year at Washington. Now, their principal exhibit consists of similar switches distributed among numerous central stations, where they are highly appreciated for their substantial character and beauty of appearance.

MR. JOSEPH SACHS, of New York, showed samples of the specialties of Rossiter, Mac Govern & Co., Solar Arc Lamp Co., and McCreary specialties. He also acted as representative for various publications and D. Van Nostrand's scientific and electrical books. The Solar arc lamps shown were of entirely new design, specially adapted for outside work without hoods, and the McCreary specialties attracted much attention on account of the beauty of the jewelled shades. Rossiter, Mac Govern & Co. showed alternating current single phase fan motors, which were offered at a very low figure.

THE HABIRSHAW WIRES AND CABLES of the India Rubber & Gutta Percha Insulating Co. were represented by Mr. J. W. Godfrey, who found himself besieged by a host of friends, admirers and acquaintances all anxious to hear his new lecture. It is the first time these specialties have been introduced, with any prominence, at a convention, so that Mr. Godfrey had the additional advantage of devoting his eloquence to a novel theme. He surpassed himself,—which is saying a good deal—but left for home at the close of the convention grumbling it had been altogether too short to allow him to do the topic justice. Mr. Godfrey reports sales as excellent. He was assisted by Mr. F. W. Harrington.

THE CLONBROCK (MORRIN) BOILER was most thoroughly and successfully represented by Mr. Morrin, its inventor and designer, whose frank disposition did not allow him to conceal his pleasure at the fact that the new president of the Association is a staunch advocate of the Morrin type for conditions where there must be a large boiler capacity in the narrowest limits,—as exemplified at the Washington street station in Chicago. Another cause of pleasure to Mr. Morrin was that he could give ocular demonstration of the validity of all his arguments at the new station of the Cleveland Electric Illuminating Co., where the Morrin boiler has been installed in all its glory, under very exacting conditions as to space and output.

MR. CHAS. L. RODMAN took good care that Globe carbons were not forgotten.

THE DAYTON FAN & MOTOR Co. through their Mr. Waymire reminded all interested that the fan motor season is close at hand.

MR. E. WARD WILKINS, of the old and reliable firm of Partrick and Carter, was among the eastern visitors.

MR. F. S. TERRY of "Sunbeam" fame met very few who needed an introduction to either him or the Sunbeam lamp.

MR. WM. D. PICKLES, manager of Warren Webster & Co., was in attendance and distributed an interesting pamphlet descriptive of the Williams vacuum system of steam heating.

MR. ROBT. FARIES, Decatur, Ills., called attention to his circulars descriptive of his incandescent lamp holder, and also of his boiler tube cleaner.

C. E. BONNELL, Craigin, Ills., found it an easy matter to convince station managers that the Tribasic boiler and Nubian enamel for exposed iron work are two necessities in every first class plant.

THE NASHOLD CLEAT Co., Chicago, were represented by Gen'l. Mgr. Nashold, who showed a line of samples of their self-locking cleat.

MR. M. A. SULLIVAN, o fthe Chicago office of Chas. A. Schieren & Co., presented the merits of "Perforated" belting in an earnest and convincing manner.

MR. GEO. W. CONNOVER, western manager for the Perkins Electric Switch Company, was an able assistant to Mr. Gates in looking after the company's interests.

PRES. W. H. MCKINLOCK of the Metropolitan Electric Co. and Mr. Shainwald of P. & B. fame arrived together and were almost inseparable during the convention.

THE H. W. JOHNS MFG. Co., of New York, were represented by Mr. Edward B. Hatch, of Hartford, who was well equipped with a fund of useful information regarding insulating material.

MICANITE products were prominently displayed in the basement, where the Cuyahoga Supply Co. the local representatives took good care of all interested.

THE JENNEY ELECTRIC MOTOR Co.'s bulletin of information was one of the neatest brochures distributed at the convention. Mr. Chas. D. Jenney was justly proud of it.

R. J. RANDOLPH, Western manager for the Excelsior Electric Company, never tired of telling about the company's latest types of lighting and power generators, especially the large arc types.

THE WALLACE ELECTRIC Co., Chicago, became still better known through the efficient efforts of Messrs. J. B. Wallace and Will Hine.

"GATES OF CHICAGO" arrived in due season and was immediately surrounded by a host of satisfied managers or superintendents who are using apparatus handled by Mr. Gates.

PROF. E. P. ROBERTS, of the Correspondence School of Technology, had headquarters in parlor 101, where at all times he had a number of visitors seeking information.

MANAGER HUGO BENEDIX, of the Bourdreaux Dynamo Brush Co. showed samples of their brushes in parlor 101. It is made of foliated metal, and is highly spoken of.

MR. J. H. PARKER, of C. S. Knowles of Boston, was present constantly in the Hollendon attending to his large interests in various electrical supplies, and secured a few good orders from some of the representative companies present.

MR. ERNEST J. BAGNALL of St. Louis, who is well known as one of the pioneers in the arc lighting business, having started as far back as 1878, came up from the Mound City and shook hands with a host of friends.

THE TUCKER ELECTRIC CONSTRUCTION Co. of New York were represented by Mr. T. McCoubray, who had an exhibit of five stations of the Auto-telephone system in operation in the lobby of the Army and Navy Hall adjoining the Convention rooms.

MR. C. J. H. WOODBURY, of the American Bell Telephone Co. of Boston, was in attendance at the Convention as one of the guests of the Association, representing the interests of his company.

THE AMERICAN CIRCULAR LOOM Co., of Boston, were represented by Mr. H. H. Brooks, and Mr. J. S. Wilson, who had a very interesting exhibit of flexible conduit in their parlor on the first floor of the Hollenden House. On the centre table they showed several coils of tube varying in size from 1¼ inches to quarter inch, and round the walls they had stretched a quantity of conduit, showing the extreme flexibility of their product, and the ease with which it can be manipulated. In the way of a souvenir Messrs. Brooks and Wilson distributed several hundred siren whistles, covered with canvas jacket tube, which served to amuse many of the delegates, and on which many a "blast" was blown in the interests of flexible conduits.

MR. EDWARD H. FOX, of the Phoenix Glass Co., was sought for by central station men who wanted the latest novelties in shades and other electrical glassware.

MR. H. T. PRATT, representing the Chicago office of the Washburn and Moen Mfg. Co., was a familiar figure among those in attendance.

THE PHILLIPS INSULATED WIRE Co., of Pawtucket, R. I., were represented by their New York manager, Mr. H. C. Adams, who had a few samples of their well known brand of insulated wires and cables for distribution amongst his friends.

MESSRS. J. H. ALLEN AND H. T. EDGAR were located in the private dining room which had been transformed into the headquarters for the coming Atlanta exposition propaganda. They did some excellent work.

MR. THRESHER, of the Shawhan-Thresher Electric Co. arrived early the first day and was kept busy answering inquiries and giving information about the company's direct coupled generators, and their iron-clad machines in general.

MR. LOUIS NAHM, of the American Electric Mfg. Co., St. Louis, arrived the second day and took excellent care of the "American" lamps. The high quality of these lamps is still being maintained and prices, Mr. Nahm states, are right.

THE WESTERN ELECTRIC Co., had their Mr. C. D. Wilkinson in attendance, who found no trouble in convincing visitors of the superior grade of the company's almost numberless products of anything electrical.

THE WALKER MFG. Co., whose extensive works in Cleveland, are one of the prominent points of interest of the Forest City, had headquarters in Room 101. Probably no line of electric light and power apparatus has so quickly gained a reputation for reliability as the Walker products.

MR. J. A. PENTZ, of Philadelphia, was present to describe the merits of the Pentz-Reckenzaun meter, and could show one to those interested in operation in the station of the Consolidated Electric Illuminating Co., of Cleveland, where it is said to be giving great satisfaction as a perfectly accurate meter.

THE LIBBEY GLASS Co., of Toledo, O., are so well known as to require no mention, or no attendant at conventions, but this year Mr. S. O. Richardson, Jr., paid his numerous friends a visit at the Hollenden and gave them the latest news on the art of making incandescent lamp bulbs.

THE FALLS RIVET MACHINE Co., of Cuyahoga Falls, N. Y., manufacturers of friction clutches for electric light and power houses, were represented throughout the whole time of the Convention by Messrs. E. L. Babcock, and C. A. Babcock, who dilated upon the peculiar properties of their clutch for electric work.

THE CLEVELAND ELECTRICAL MFG. Co., of Cleveland, O., showed some samples of their American Watchman's time detector, and represented the Paranite wire, made by the Indiana Rubber and Insulated Wire Co., of Marion, Ind. They distributed a number of useful wiring calculators to the delegates, as a souvenir, which were in great demand.

THE FORT WAYNE ELECTRIC CORPORATION, of Fort Wayne, Ind., were represented by Messrs. G. A. Wilbur, C. S. Knight, T. J. Ryan, Tom Cooper, C. E. Wilson and S. A. Douglas, who had a comfortable parlor but no exhibit. They distributed, however, a large number of souvenirs representing in miniature their regular 500 light wood transformer, intended for use as paper weights. They proved a great attraction, as proved by their speedy disappearance.

THE WESTON ELECTRICAL INSTRUMENT Co., of Newark, N. J., were represented by Mr. Chas. T. Shain and Mr. R. O. Heinrich, who had an attractive exhibit of their handsome instruments in one of the parlors of the Hollenden. The most novel of their exhibits consisted of total output station ammeters up to 80,000 ammeters, the largest size having a scale measuring three feet, and the whole instrument weighing 175 pounds. They also showed samples of their regular measuring instruments for different purposes, and of varying design.

THE ELECTRIC SELECTOR AND SIGNAL Co. of New York, were represented by our old friends Mr. P. H. Alexander, C. P. Mackie, and A. L. Searles, who had an exhibit of their novel system of cutting in and out of arc lamps or converters at a distance from the central station, by means of an automatic device in the station. They showed a number of arc lamps in series, and by means of their selector, could make any lamp start up at any moment, or cut it out when desired. This was perhaps the most novel exhibit at the Convention. It certainly attracted an immense amount of interest, it being difficult to get near their exhibit at any hour of the day or evening.

THE MULTIFUSE SWITCH CO., Cleveland, showed their combination switch and fuse box, in charge of Mr. A. W. Mayers.

THE H. T. PAISTE COMPANY'S interests were looked after by Mr. Paiste, who carried their exhibit in his overcoat pocket.

THE NUTTING ELECTRIC MFG. CO. were represented by their engineer, Carl K. McFadden, who never tired of showing the simplicity of the "wax-wheel" lamp.

MR. M. M. WOOD, inventor, patentee and manufacturer of electric light and railway specialties was in attendance, showing also a model of the Eureka porcelain cleat of heroic size.

THE CRANE COMPANY, Chicago, had Mr. G. A. Hurd in attendance, who explained the merits of their high pressure gate valve and the Crane patent pop valve.

THE FOREST CITY ELECTRICAL WORKS, of Cleveland, O., were represented by Mr. W. B. Cleveland, who showed a large quantity of their roll drop commutator bars, in every size and shape, for all kinds of dynamos and motors.

THE MICHIGAN ELECTRIC CO., Detroit, had one of the Detroit Electrical Works generators on exhibition. The company is the general selling agent for these machines built after the design of Mr. Gilbert Wilkes. The exhibit was in charge of Mr. Joseph Lockwood.

THE ELECTRIC APPLIANCE CO., Chicago, were ably represented by their president, Mr. Low, who distributed a neat Souvenir in the shape of a pocket etui filled with an assortment of fuse wires.

THE J. C. MCNEIL CO., Akron, O., showed a working brass model of the Cook Boiler, demonstrating the positive and complete circulation claimed for this type. Mr. J. B. Campbell, secretary and treasurer was in charge.

THE CUTLER-HAMMER MFG. CO., Chicago, had a most complete exhibit of their rheostats and motor starting switches, as well as a complete line of storage battery supplies. Mr. Cutler personally explained the many meritorious points of their products.

THE NEW YORK INSULATED WIRE CO. as far as the Chicago office is concerned, were ably represented by their Mr. Jas. Wolfe, who took good care that the merits of Grimshaw Wire and Vulca ducts were not lost sight of.

THE PAGE BELTING CO., of Concord, N. H., were represented by Mr. George F. Page, president of the company, and Mr. J. H. Burghardt, their well known and popular salesman in the east. Mr. Burghardt showed some handsome samples of the Eureka slotted dynamo belt, but did not make any elaborate exhibit.

THE PACKARD ELECTRIC CO. showed samples of their transformers and accompanying cut out. To exhibit the perfect insulation of their transformer they showed one in operation under water, which created no little astonishment among central station men.

THE BRYANT ELECTRIC CO.'s souvenir book met with decided favor, the large edition becoming exhausted the first day. They had a complete line of their specialties on exhibition behind the "big pillar" in the basement. Messrs. W. C. Bryant and Thos. G. Grier did the honors, booking several nice orders.

THE PERU ELECTRIC MFG. CO. could hardly have found a more efficient exponent of their wares than Mr. Jas. McGill, who had a nicely arranged sample board of their various porcelain goods. A line of the several types of the Laclede and Hercules batteries was also shown.

MR. HUGO BENEDIX, of Chicago, showed some samples of the Bourdreaux foliated dynamo brush, which bids fair to become a formidable rival of the several types of wire gauze and carbon brushes, to judge from the many flattering testimonials contained in a circular issued by the company.

GEO. CUTTER, Chicago, showed samples of his lamp supporting pulley, also the 1895 model incandescent street hood, Cutter's new arc lamp windlass, voltmeter switch and a new soldering device for inside wiring. Mr. Albert Scheible looked after the local trade for Mr. Cutter.

MR. CHAS. E. GREGORY, Chicago, was present and distributed some more of his neat souvenirs in the shape of a handsome half-tone engraving, entitled "Four Stockholders in the Chas. E. Gregory Co." He also called attention to the large list of customers of his house, the list being arranged in the form of a neat pamphlet.

THE ANCHOR ELECTRIC CO. of Boston were represented by Mr. Norman Marshall who showed a board mounted with their well-known specialties in sockets, switches, cut-outs, etc. They also showed samples in their new Anchor tree insulator and Anchor cleat, both halves of which are exactly alike; and the Dow lamp cord adjuster, a most useful device for raising and lowering incandescent lamps suspended by lamp cord. Although they did not show any of their Watchmen's Clocks, they distributed a large number of sample dials from their printing watchman's register, which proved quite interesting reading matter to those wishing to reduce the insurance on their factories.

THE WAGNER ELECTRIC MFG. CO. had an interesting exhibit of their transformers, including their new type D, which marks quite a new departure in the mechanical design of converters. The new lava fuse plugs are guaranteed not to arc with five thousand volts. Mr. E. H. Abadie was in attendance, Mr. Wagner arriving the second day.

THE DIAMOND ELECTRIC CO. were represented by their manager of the sales department, Mr. A. M. Searles, assisted by Mr. H. B. Warren. Samples of the Diamond transformer and the new Scheeffer recording wattmeter were shown. The latter was favorably commented upon by many who noticed its great simplicity.

THE AKRON INSULATOR & MARBLE CO., of Akron, O., exhibited a variety of samples of their floor and window tubes, circuit breakers, and electrical specialties. Their goods are all made of perfectly vitrified non-porous, non-absorbing clay, which make them perfect insulators and absolutely fire proof. The exhibit was in charge of Mr. A. L. Daniels.

THE NEW YORK & OHIO CO. were represented by Messrs. J. W. & W. D. Packard and H. M. Willson who exhibited a complete line of the well known Packard lamps. Quite a novel feature consisted of a 2½ watt 800 C. P. stereopticon lamp and focussing outfit, which takes the place of the cumbersome calcium apparatus, and can, it is claimed, be operated much more cheaply.

THE BELKNAP MOTOR CO., of Portland, Me., made a very attractive exhibit of their composite woven wire and graphite dynamo and motor brushes and brush holders. By means of revolving discs on which were mounted incandescent lights, the exhibit was made to attract considerable attention, and at the same time to show the value of their specialties. The exhibit was in charge of Mr. R. B. Smith, of Philadelphia.

W. L. WALKER & CO., of Boston, were represented by Mr. Walker himself, who showed a sample of a lot of 800 Thomson Rice arc lamps, which they have recently bought and which they are willing to sell in any quantity. Mr. Walker is getting to be one of the leading second-hand dealers in the country, and distributed a number of circulars showing what he has on hand at the present moment.

PERKINS ELECTRIC SWITCH MFG. CO., of Hartford, Conn., showed a handsome board on which were mounted samples of their regular line switches, sockets, dovetailed rosettes, in all styles and variety of design. The board was well illuminated by two Waterhouse-Gamble incandescent arc lamps, and the exhibit was well taken care of by Mr. J. J. Gates, general manager of the company and Mr. G. W. Conover, their Chicago manager.

THE ELECTRIC CO. of New York, were represented by Mr. C. R. Duffie, Jr., who showed an incandescent lamp, mounted on one of their economic regulating sockets, suitable for direct or alternating current. By means of this socket five gradations of light can be had, with a saving of current of 69 per cent. at the meter, at the lowest gradation. The socket being put on the market is exactly the same size as any ordinary socket, and is being listed at one dollar.

THE ELWELL-PARKER ELECTRIC CO. OF AM. were represented by Messrs. Phillips and Moore. Their exhibit was made at the Brown Works, where they have a quantity of apparatus passing rapidly through the shops to fill urgent orders. Their latest contract is for a 1,000 h. p. generator for use in railway work in Cleveland. The company are forging ahead slowly but surely, determined to win for their product at the outset a reputation that will endure.

TELEPHONE NOTES.

MARTINSVILLE, IND., is to have a new telephone exchange.

BROOKVILLE, IND.—Business men of Brookville have organized a company to put in a telephone system to the surrounding towns.

ROCKFORD, ILL.—The new long distance telephone from Rockford to New York, Washington and other eastern cities has been opened.

TIFFIN, O.—The Central Union Telephone Company will put in, about April 1, a long distance telephone between Tiffin and Sandusky, where it will connect with the long distance line running along the Lake Shore railroad. By this arrangement a resident of Tiffin can talk with a friend in New York, Chicago or Washington.

STEVENS POINT, WIS.—Public meetings have been held at Stevens Point, Grand Rapids, Centralia, Marshfield, Wausau and Merrill, and committees appointed to demand from the Wisconsin Telephone company cheaper and better telephone service. If the telephone company refuses to grant their request these cities propose to establish an independent system.

REPORT OF TEST OF TRIPLE EXPANSION ENGINE BUILT BY SOUTHWARK FOUNDRY AND MACHINE CO., PHILADELPHIA, FOR THE CHICAGO EDISON COMPANY'S HARRISON STREET STATION.

IN the extended article by Mr. T. C. Martin, on the stations and work of the Chicago Edison Co., appearing in THE ELECTRICAL ENGINEER of Jan. 23, reference was made to the engine equipment of the company's new Harrison street station. Of the ten triple expansion engines in that station, eight were furnished by the Southwark Foundry & Machine Co., of Philadelphia, under strict guarantees. Before acceptance one of these engines was subjected to a test which was carried out by Prof. H. W. Spangler, Professor of Mechanical Engineering, University of Pennsylvania, on behalf of the Southwark Co., and Mr. B. R. T. Collins, B. S., late Instructor at the Massachusetts Institute of Technology on behalf of the Chicago Edison Co. The engines are probably the highest speed vertical engines of their size driving direct connected dynamos and the results obtained are so eminently satisfactory that we give the report in full below:

WE have the honor to make the following report of a test of engine No. 11 in the Harrison Street Station of the Chicago Edison Company, conducted by us on December 28, 1894.

The engine tested was one of the 2-200 K. W., 530 H. P. triple-expansion engines built by the Southwark Foundry & Machine Company, having cylinders 13½", 21½" and 36" diameter by 30 inches stroke, designed to be run at 145 revolutions per minute and at that speed developing 530 I. H. P. with an economy of 13.5 pounds of water per horse-power. It has been found desirable to run these engines at a higher speed because of the dynamos, the armatures of which are carried on the shaft of the engine and during the test the speed of the engine averaged 157.4 revolutions per minute.

As the engines were designed for that cut-off which would give maximum economy at 145 revolutions, to obtain as nearly as possible these conditions which had been determined upon by the builders, the power developed in the engines was taken to be $\frac{157.4}{145}$ times 530 H. P. or 575.3 H. P.

The average horse power developed during the test was 574.4, which was as close to that asked for as could be expected. The engines were still handled under unfavorable conditions, as the ports, passages, etc., were designed for the slower speed and the diagrams taken of the pressure in the valve chest and in the steam pipe outside of the throttle show a larger variation in pressure than would probably have been the case at the slower speed, the variation of pressure in the steam pipe on the boiler side of the throttle valve being 18.8 pounds and in the high pressure valve chest 19.7 pounds, the average pressure shown on the throttle diagram being 169.5 pounds, the pressure in the cylinder falling 17.5 pounds below this.

The cylinder heads of each cylinder are jacketted, full boiler pressure being carried in the jackets on the high and intermediate cylinders, and steam of 60 pounds pressure being carried on the low pressure jackets.

Method of Making the Test.—All the steam used in the cylinders was condensed in a surface condenser, the air pump discharging into one or the other of the two tanks on platform scales. These tanks were weighed both empty and full and the time of changing from one tank to the other noted. From this data the line, Fig. 1, marked "Water per Minute Condenser" has been plotted, the average quantity per minute being plotted at the middle of the interval.

The condensed steam from each of the two sets of jackets was discharged by a trap into independent tanks on scales. These tanks were partly filled with cold water to prevent loss by evaporation and then weighed. The jacket traps were then allowed to discharge into these tanks and at the end of each half hour were closed off and the water allowed to accumulate in the traps until the tanks were weighed, emptied, partly filled with cold water and again weighed. From the data thus obtained, the line of "Water per Minute Jackets" was drawn as above described. From water per minute from "Condenser" and from "Both Jackets," the line of "Total Water per Minute" was obtained.

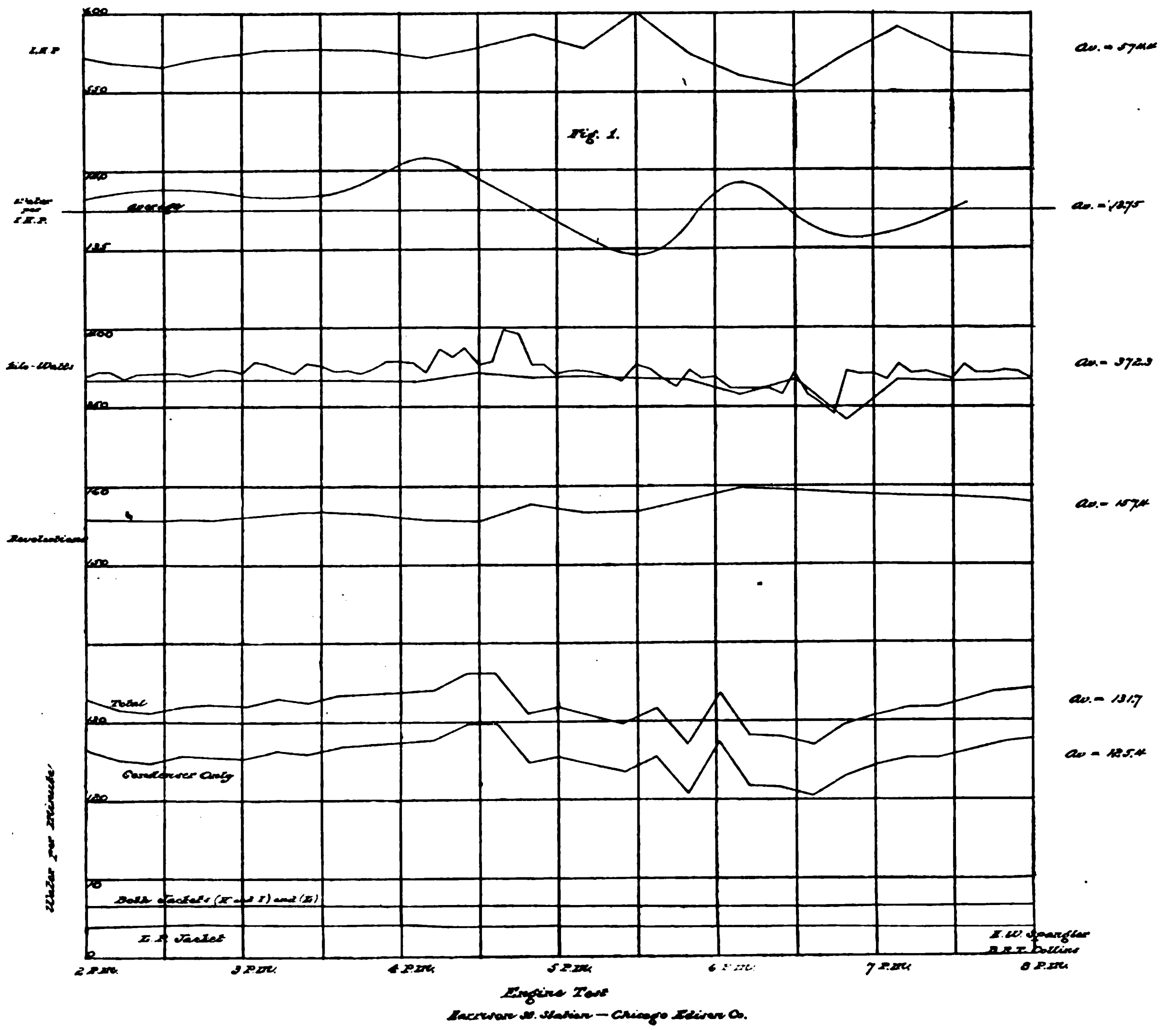


FIG. 1.—DIAGRAM SHOWING RESULTS OF TESTS ON SOUTHWARK TRIPLE EXPANSION ENGINES, CHICAGO EDISON STATION.

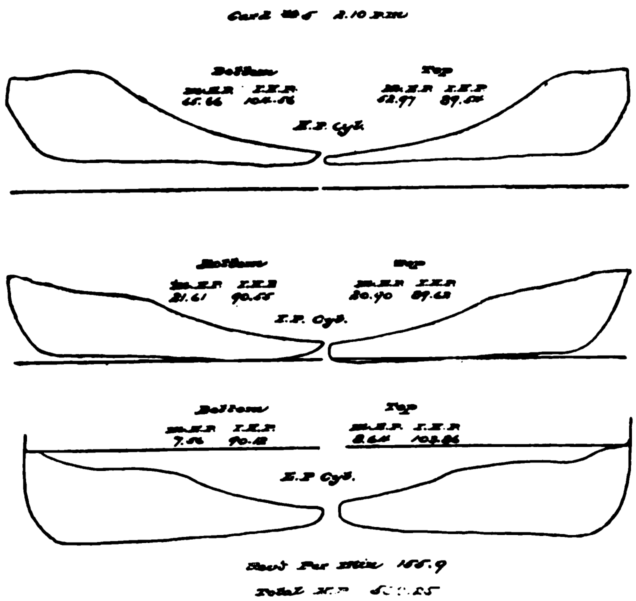


FIG 2.

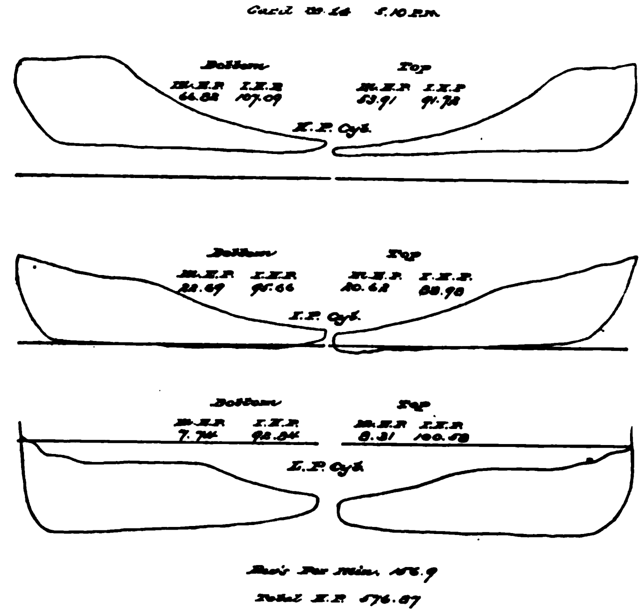


FIG. 3.

To determine whether the condenser was tight or not, it was closed off from the engine and the air pumps run to give the usual vacuum with the usual pressure of the condensing water on the other side of the tubes. No water was delivered by the air pumps in an hour's run. This was done both before and after the test. All the scales on which the water was weighed were tested before and after the test and the scale beams and weights were correct.

Six Crosby indicators were used, one on each end of each cylinder, the motion being reduced by pantographs which were tight in the joints. These indicator cards were taken by six observers and as nearly simultaneously as can be done in this way. The indicator springs were standardized both before and after the test and the average of the two values thus obtained was taken in determining the horse power from the cards. The springs used on the high and intermediate cylinders were tested under steam between the limits which existed in the cylinder on which they were to be used and the springs used on the low pressure were compared with a mercury column, the vacuum on one of the engines being partly broken to obtain the range, the comparison being made with a mercury column. Check counters were used on the engines to register the revolutions.

All other connections into the condenser through which steam might leak into the condenser and all drip pipes from the engine were broken and the stuffing-boxes were tight so that practically all the steam used in the engine went into the condenser or into the jacket traps.

Results.—The test began at 2 P. M., December 28, and ended at 8 P. M. Fig. 1 shows in graphical form the results of the test.

The topmost line shows the variation in horse power during the test. The cards, taken every twenty minutes, were worked up and the results plotted. The average horse power is 574.4, the maximum 600.48 and the minimum 552.29. The load on the engine was fairly uniform for the first three hours of the test, but after 5 P. M. there was considerable difficulty at the switchboard in keeping the load as desired, the diagram showing quite considerable variation. The table herewith shows the distribution of the power between the cylinders.

Time.	H. T.	H. B.	Total High.	I. T.	I. B.	Total Intermediate.	L. T.	L. B.	Total Low.	Total Engine.
1.50 P. M.	89.15	105.49	194.64	91.01	90.87	181 38	106.53	92.53	199.06	575.08
2.10	89.54	104.56	194.10	89.62	90.55	180.17	103 86	90.12	193 98	568.25
30	87.70	105.23	192.93	91.29	90.49	181.78	100.03	91.84	191 87	566.08
50	90.59	105.55	196.14	93.31	93.21	186.52	97.81	92.02	189.83	572.49
3.10	90.03	108.98	199.01	90 95	96.75	187.70	98.87	90.97	189 84	576 05
30	90.66	107.21	197.87	88.75	96.65	185.40	99.41	93.78	193.19	576.46
50	91.60	107.88	199.48	88 69	94.15	182.84	102.19	91.29	193.48	575.80
4.10	89.54	104 75	194.29	87.20	94.54	181.74	102.29	92.25	194 54	570.57
30	91.08	106.90	197.98	87.49	97.07	184.56	99.25	95.17	194.42	576.96
50	93.66	109.20	192.86	88.61	97.09	185 70	102.74	94.52	197.26	575 82
5.10	91.72	107.09	198.81	88.98	95.66	184.64	100 58	92 84	193 42	576.87
30	96.79	104.56	201.35	97.40	106.38	203 78	101.59	93.76	195.35	600.48
50	88 87	108.42	197.29	85 38	92.47	177.85	97.81	99.87	197.68	572.80
6.10	90.47	99 54	190.01	83.81	91.68	175.49	99.99	94.23	194.22	559.72
30	90.39	106.98	197.37	82 66	86 96	169.62	94.70	90.60	185.30	552.29
50	96.58	102.12	198.70	89 63	96.07	185.70	94.10	94.26	188.36	572.76
7.10	95.26	107.45	202.71	90 05	96.12	186.17	101.15	100.04	201.19	590.07
30	93.44	108.68	197.12	90 05	95.76	185.81	98.12	92.51	190.63	573.56
50	92.51	105.06	197.57	89.24	96.00	185.24	101.19	88.78	189.97	572.78
8.10	89.31	105 89	195.20	90.42	94.69	185.11	97.06	92.39	189.45	569.75
Means.	91.87	105.99	197.86	89.25	94.60	183.85	99.89	93.31	193.20	574.41

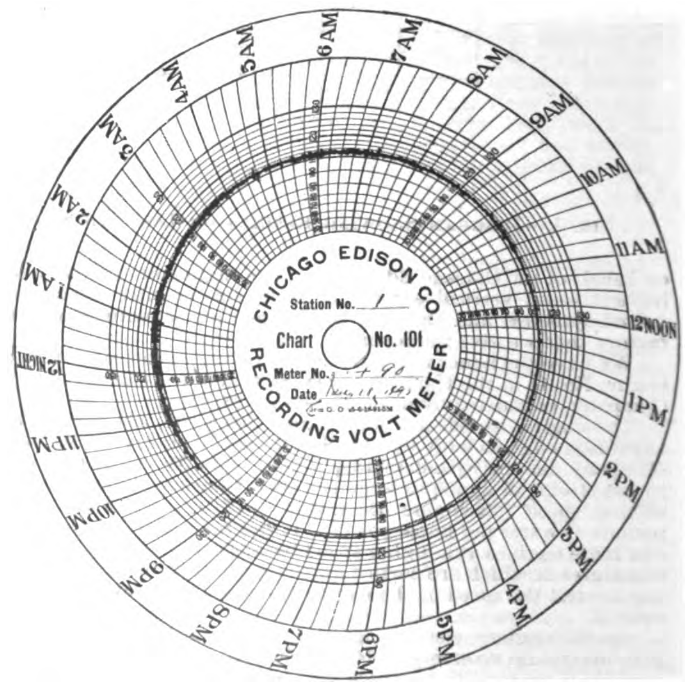
The variation in load between the cylinders and between the same end of the cylinders was due partly to the varying load and partly to the changes which were made in the adjustment of the valves during the test.

Two sets of diagrams are reproduced herewith, those of set No. 5, Fig. 2, taken at 2.10 P. M. and those set of No. 14, Fig. 3, taken at 5.10 P. M. These particular ones are selected as being fairly close to the mean horse power, one being above and one below the mean. As an additional matter of interest, these two sets of cards were also worked up to determine the amount of (initial) condensation in the cylinder, the results being given below, in pounds:

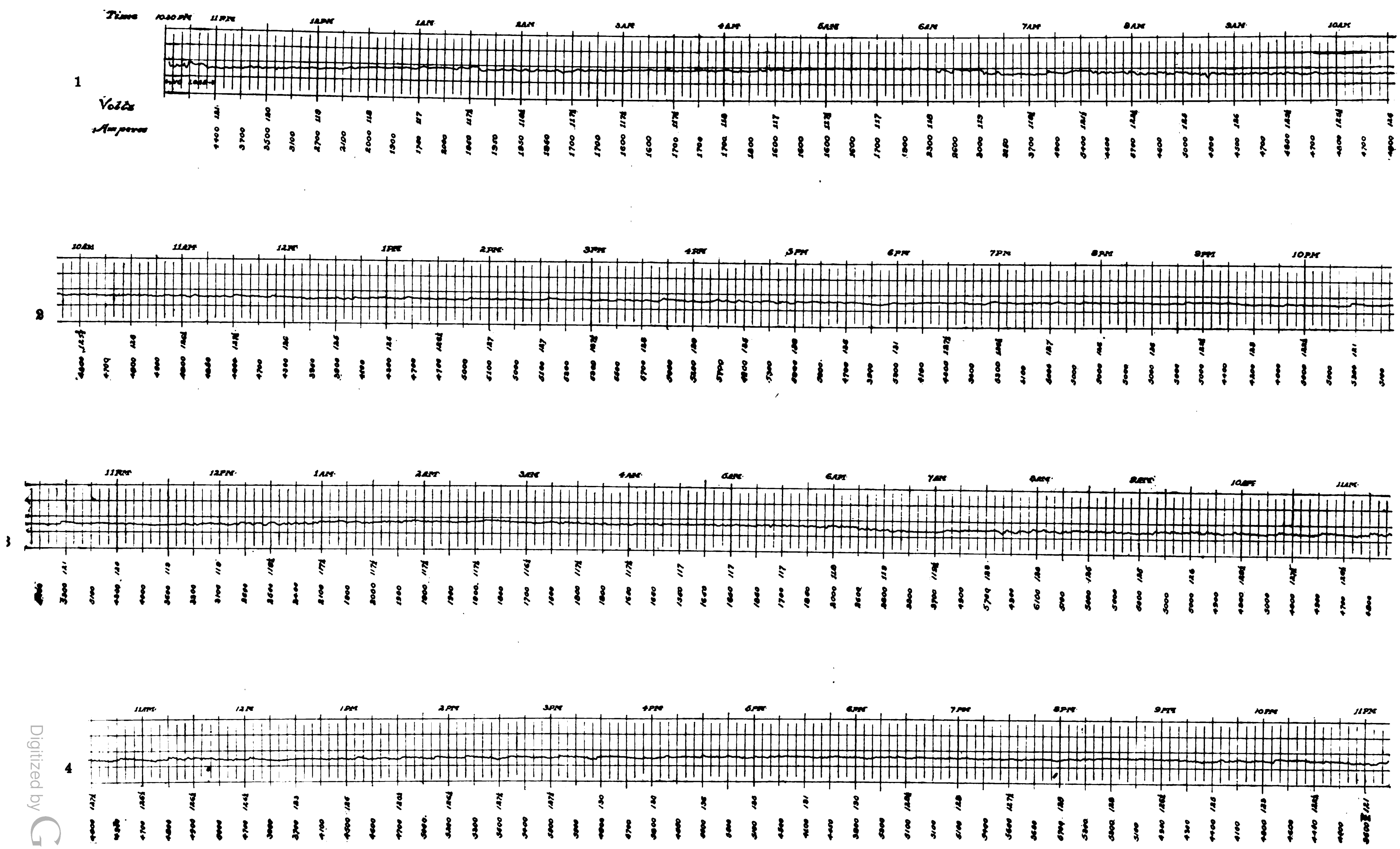
	Card No. 5.		Card No. 14.	
Total water per stroke	.8417		.8316	
Water in cylinders per stroke............	.8018		.7922	
Water in H. & I. jackets per stroke, ...	.0148		.0154	
Water in L. jacket per stroke............. ...	.0251		.0242	
Water accounted for in cylinders:				
H., top.................. .	.2567		.2563	
		total .5577		.5649
H., bottom	.3010		.3086	
I., top.	.2841		.2696	
		total .5819		.5715
I., bottom...........	.2978		.3019	
L., top.....................	3372		.3271	
		total .6431		.6924
L., bottom................	.3059		.3653	

	Card No. 5.		Card No. 14.
Initial Condensation ....H	= 30.4%	.2441,	H = 28.7% = .2273
I	= 27.4%	.2199,	I = 27.9% = .2307
L	= 19 8%	.1567,	L = 12.6% = .0998

The third line on Fig. 1 is the number of kilowatts output of



DYNAMO PRESSURE RECORDED ON BRISTOL RECORDING VOLTMETER.



CONTINUOUS RECORD OF 48 HOURS RUN MADE BY MOSCROP SPEED RECORDER, ON SOUTHWARK TRIPLE EXPANSION ENGINE, CHICAGO EDISON CO.

(The Record, owing to its Length, had to be Divided into Four Parts which Follow One Another in the Numbered Order.)

the two dynamos on the engine, the voltage being taken at the dynamos. The voltmeters were standardized by the station people and taking the amperemeters as correct, the line represents the variation of the total load. The broken line is the result of five minute observations, the other line representing the ordinary readings of the switchboard attendant. The maximum load was 398.03, the minimum 345.93 and the average 372.8.

If the instruments are correct, the output of the engine and dynamo is 648 watts per indicated horse power, an efficiency of 86.8 per cent.

The next curve represents the variation in speed during the test. The speed was very uniform during the first three and one-half hours of the test, the speed gradually increasing until 6.10 P. M. The average revolutions was 157.4, the maximum being 160 and the minimum 155.8, the greatest variation for the average speed being 1.65 per cent.[1]

Beginning again at the bottom of the diagram, Fig. 1, the first line represents the quantity of water discharged from the low pressure jacket trap. This water averaged 3.88 pounds per minute and was 2.95 per cent. of the total water used by the engine.

The next line marked "Both Jackets" is the quantity of water discharged from both traps, the difference between this line and the next lower one indicating the amount discharged from the jackets on the intermediate and high pressure cylinder heads. The average amount discharged from the high pressure trap was 2.4 pounds per minute, or 1.82 per cent of the entire amount of steam used by the engine, the total jacket water being 6.28 pounds per minute, 4.77 per cent of all the water used.

The next line, marked "Condenser Only" represents the quantity of steam actually passing through the cylinders and varied from 129.8 to 120.7 pounds of water per minute, the average value being 125.4 pounds. The line above this, marked "Total" represents all the water used by the engine and is the sum of the amounts shown on the lines marked "Condenser Only" and "Both Jackets."

A comparison of the lines on the diagram show that generally the quantity of water used varied inversely with the number of revolutions, the greatest quantity of steam being discharged at the lowest speed, which does not however correspond with the greatest horse power but does correspond with nearly the maximum output of the dynamos.

The remaining curve, the one next to the top, was determined in the following way: Beginning at 1.50 P.M., the average horse power was determined and the average quantity of water used by the engine per hour, the readings for forty minutes being taken. The amount of steam per I. H. P. was plotted at the centre of this interval, or at 2.10. From 2.30 to 3.10 the water per H. P. was determined in the same way and plotted at 2.50. The points marked on the line are those actually determined, the points being joined by a fair curve.

Fig. 2 is a reproduction of the set of cards taken at 2:10 P.M., the average water consumption being 13.86 pounds of water per I.H.P. per hour. Fig. 3 is a reproduction of the set of cards taken at 5:10 P.M., the water consumption being 13.57 pounds of water as taken from Fig. 1. The maximum consumption of water per I.H.P. was 14.07 pounds and the minimum 13.45 pounds, the average for the entire test being 13.75 pounds.

Fig. 4 represents two sets of simultaneous diagrams, the upper set being taken at the same instant and showing the variation in pressure on both sides of the throttle valve. The vertical scale of these diagrams is 116.9 pounds per inch. The mean pressure for this card is 169.5 pounds at the throttle, and practically the same in the valve chest. The lower set of diagrams were taken at the same instant and are here reproduced to show the difference between the pressure in the valve chest and the maximum shown in the cylinder. This difference on the cards shown is 17.5 pounds. During the test a superheating calorimeter was used on the steam pipe near the throttle valve, the steam being taken from the bottom of the pipe. The average moisture in the steam was 1.4 per cent.

The following table gives these results in tabular form.

TABLE OF RESULTS OF TEST.

Water per hour from condenser	7523.9 lbs.	95.2 % total.
" " " " H. & I. Jackets	144.0 lbs.	1.8 % total.
" " " " L. Jackets	233.0 lbs.	3.0 % total.
Total	7899.9 lbs.	
Average water per minute	131.7 lbs.	
Horse Power.		
Average High Pressure, Top	91.37 h.p.	
" " " Bottom	105.99 h.p.	
" " " Total		197.36 h.p.
" Intermediate, Top	89.25 h.p.	
" " Bottom	94.60 h.p.	
Total		183.85 h.p.
" Low Pressure, Top	99.89 h.p.	
" " " Bottom	93.31 h.p.	
Total		193.20 h.p.
Brought forward		193.20 h.p.
" Total horse power from engine		574.41.
Maximum horse power		600.48 h.p.
Minimum horse power		552.29 h.p.
Average water consumption per i.h.p		13.75 h.p.
Maximum		14.07 lbs.
Minimum		13.45 lbs.
Gauge pressure at engine (average)		174.8 lbs.
Maximum		178.0 lbs.
Minimum		171.0 lbs.
Vacuum in condenser (average)		26.3 in.
Maximum		26.6 in.
Minimum		25.6 in.
Barometer		29.75 in.
Moisture in Steam (average)		1.4 %
Pressure in first receiver (average)		38.2 lbs.
Pressure in second receiver (average)		0 0 lbs.
Revolutions, average per minute		157.4.
Maximum		160.0.
Minimum		155 8.

1. In order to show the variations of speed in detail we add a complete record, made by the Moscrop continuous speed recorder which was employed during the test, covering a period of 48 hours. To this is added a record made by the Bristol recording voltmeter, showing the pressure at the terminals of the bus-bars, on Jan. 18.

LEGAL NOTES.

EDISON ELECTRIC LIGHT CO. vs. UNIVERSAL ELECTRIC CO.—AN INJUNCTION.

At Cleveland, on Feb. 16, an opinion in the suit of the Edison Electric Light Company against the Universal Electric Company, of that city, was handed down by Judge Ricks. The suit was to enjoin the manufacture of an alleged infringing variety of incandescent lamp, and the court held that the plaintiff was entitled to the action prayed for. A decree was to be prepared in accordance with the opinion.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 94th meeting of the Institute, will be held at 12 West 31st Street, New York City, on Wednesday, February 27th, at 8 P. M. A paper will be presented by MR. H. WARD LEONARD, of New York City, entitled, "Notes on Recent Electrical Engineering Developments in France and England." Among the topics treated will be, Rotary Transformers; the Parsons Steam Turbine; the Laval Steam Turbine; English and French Central Stations, the Heilmann Locomotive, etc.

A meeting of Western members will be held the same evening, Wednesday, February 27th, at Armour Institute, 33rd Street and Armour Avenue, Chicago, where the above paper will also be read and discussed. Members of other engineering societies are especially invited to attend.

The February issue of the Transactions, containing the above paper will be distributed in advance of the meeting.

LETTERS TO THE EDITOR.

THE MAGNETIC BRUSH HOLDER.

THE ELECTRICAL ENGINEER of Feb. 13 contains a note from Mr. Frank J. Sprague, concerning his anticipation of the above invention. I do not question for a moment the facts recited by Mr. Sprague, but I think he makes an unintentional slip when he says "although *possibly* novel with Mr. Henry the scheme itself is not original." I think Mr. Sprague with his characteristic frankness would admit that this is a pure guess on his part, and that he has no information concerning my dates of conception and experiments, and that he will appreciate my reluctance to talk of them. I think he will also agree with me that in patent matters abandoned experiments do not count.

J. C. HENRY.

PUEBLO, COL.

EARNINGS OF THE NEW YORK EDISON CO.

The Edison Electric Illuminating Co., of New York, show the following comparative earnings for January:

	1895.	1894.	
Gross	$166,953.05	$135,184.28	$31,768.77 Inc.
Net	93,703.14	76,843.53	16,859.61 Inc.

HAMMERSTEIN'S NEW MUSIC HALL, to be erected on Broadway, between 44th and 45th Streets, New York, is to have a 5,000 light electric light plant consisting of a pair of engines and dynamos. The Cammeyer Building at the corner of 6th Avenue and 20th Street is to be equipped with a 2,500 light plant. Full particulars regarding these plants can be obtained from Mr. Fremont Wilson, consulting electrical engineer, 108 Fulton Street, New York.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEB. 19, 1895.

Accumulators :—

Storage Battery, G. A. Ford, Cleveland, O., 534,603. Filed Aug. 11, 1894.
The cell is built up of a series of porous pans to which the active material is applied, ranged one above the other.

Alarms and Signals :—

Alarm Gauge Testing Mechanism, W. H. Bradt, Troy, N. Y., 534,311. Filed Feb. 10, 1894.

Electric Bell, W. A. Harvey, Scranton, Pa., 534,330. Filed Oct. 19, 1894.
The energising coil is wound directly on the vibrating armature.

Railway Signaling Apparatus, W. H. Walsh, Albany, N. Y., 534,414. Filed Sept. 26, 1894.
A railway crossing signal.

Electric-Bell System for Street-Railways, E. L. Stansberry & J. Bettinger. St. Louis, Mo., 534,485. Filed May 7, 1894.
A bell is placed at either end of the car; both are rung simultaneously by push buttons.

Electrical Alarm or Bell, G. F. Atwood, Orange, & J. W. Aylsworth, Newark, N. J., 534,595. Filed May 28, 1894.
Claim 4 :—
An electrical alarm or bell having an operating electro-magnet and a resistance coil or coils of carbon wound on the same core or cores as are the energising coils of the magnet and connected in series therewith, in combination with circuit connections whereby the operating current is conveyed through the resistance coil and the electro-magnet demagnetised.

Electrical Alarm for Street Cars, G. F. Atwood, Orange, J. W. Aylsworth, Newark and W. H. Miller, Orange, N. J., 534,597. Filed May 28, 1894.
When the speed regulating mechanism is turned in one direction a moderate alarm is sounded and when turned in the other direction a loud alarm is sounded; when in the central position the bell does not ring.

Conductors, Conduits and Insulators :—

Electrical Conductor, G. F. Atwood, Orange, and J. W. Aylsworth, Newark, N. J., 534,596. Filed May 28, 1894.
Claim 9 :—
A flexible carbon conductor surrounded throughout its length with a coating of insulating material and wound in spiral form upon a spool, bobbin or support.

Distribution :—

Electric Current Distributing System, G. B. Pennock, Boston, Mass., 534,281 Filed June 1, 1894.

Dynamos and Motors :—

Magneto Electric Machine, H. J. Smith, Pompton Lakes, N. J., 534,288. Filed June 8, 1894.
A magneto designed for blasting purposes in which the current is automatically shifted from one blasting circuit to the next.

Electric Rotary and Revoluble Air Circulating Fan, S. M. Pierce, Kansas City, Mo., 534,431. Filed Oct. 20, 1894.
The motor is pivoted and carries a vane on one side which revolves it, due to the air blast directed against it by the fan blades.

Electrically-Operated Dental Engine, W. E. Wheeler, Dayton, Tenn., 534,536. Filed Oct. 6, 1893.
The motor is operated by a friction drive wheel the speed being varied by shifting the friction wheel from centre to circumference of the driving wheel.

Lamps and Appurtenances :—

Reflector for Arc Lamps, C. Coerper, Cologne, Germany, 534,424. Filed May 15, 1894.
Claim : —
In an electric arc lamp, the combination, with a central main reflector supported with the globe by the supporting-rods of the carbons, of an annular auxiliary sectional reflector surrounding the central reflector and being located within the globe of the lamp.

Miscellaneous :—

Coffin, F. Egerland and J. M. Freese, Sioux Falls, S. D., 534,234. Filed Nov. 15, 1894.
Electrical alarm device to prevent suffocation of persons accidentally buried alive.

Apparatus for Production of Oxygen and Hydrogen by Electrolysis, P. Garuti, Florence, Italy, 534,259. Filed Sept. 14, 1893.
Surrounds the electrode by casings through which the gases are drawn off.

Art of Blasting, H. J. Smith, Pompton Lakes, N. J., 534,289. Filed June 8, 1894
Passes the current successively through different sections of the blasting circuit.

Electric Winding and Synchronizing Device for Clocks, C. M. Crook, Chicago, Ill., 534,318. Filed June 23, 1894.

Electric Clock Synchronizer, C. M. Crook, Chicago, Ill., 535,319. Filed July 2, 1894.
The setting of the hour and minute hand also sets the seconds hand, the latter being frictionally connected to the driving train; the minute hand revolves about a different centre from the seconds hand and the minute hand is driven independently of the train which drives the seconds hand.

Electric Winding Mechanism for Clocks, C. M. Crook, Chicago, Ill.. 534,320. Filed Dec. 15, 1894.

Stopping Device for Knitting Machines, C. W. Kutz, Fleetwood, Pa., 534,384. Filed March 31, 1894.

Electrical Apparatus for Operating Dental Implements, O. H. Pieper & A. F. Pieper, San José, Cal., 534,374. Filed April 30, 1894.
An enclosed motor supported on a swiveled bearing.

Production of Alcoholic Liquors, O. Lugo & H. T. Jackson, New York, N. Y.. 534,400. Filed June 6, 1894.
The current is applied by means of aluminum electrodes, the liquors being afterwards retained in contact with partially charred wood.

Electrical Brush, A. L. Sonn, Lansingburg, N. Y., 534,528. Filed Oct. 15, 1894.

Electric Brush, A. L. Sonn, Lansingburg, N. Y., 534,529. Filed Sept. 24, 1894.

Railways and Appliances :—

Trolley Wire Support, M. F. Van Buren, Philadelphia, Pa., 534,411. Filed Oct. 5, 1894.

Conduit Electric Railway, W. Simon, Nuremberg, Germany, 534,451. Filed March 3, 1894.
An electrically driven motor carriage makes contact between upper and lower conductors in the conduit.

Conduit Electric Railway System, W. L. Hedenberg, New York, N. Y., 534,475. Filed June 5, 1894.
Provides means whereby the surface conducting plates are entirely out of circuit with the feed wire except while the car is passing over the plate; the feed wire is placed in a water tight conduit.

Conduit Electric Railway, O. Cohen, New York, N. Y., 534,495. Filed May 15, 1894.
The track rail is utilized for supporting the circuit wire.

Conduit Electric Railway, A. Rosenholz, San Francisco, Cal., 534,519. Filed May 22, 1894.
Employs a tilting switch mechanism for conveying the current to the car.

Trolley Wire Switch, F. M. Zimmerman, Detroit, Mich., 534,592. Filed Nov. 2, 1893.

Trolley-Wire Crossing, C. S. Hersh and E. F. Weaver, Philadelphia, Pa., 534,605. Filed March 13, 1894.

Tower Wagon for Electric Line Work, J. H. Leonhardt, Baltimore, Md., 534,608. Filed Dec. 29, 1894.
The wagon has a tilting platform.

Trolley Wire Support, M. T. Murphy, New Orleans, La., 534,613. Filed Sept. 14, 1894.
The trolley wire is suspended so as to yield vertically in case of excessive pressure from beneath.

Switches and Cut-Outs :—

Electric Light Switch, H. W. Lawrence, Denver, Col., 534,269. Filed May 31, 1894.
A ratchet push switch.

Circuit Making and Breaking Device, S. W. Stratton, Chicago, Ill., 534,586. Filed July 2, 1894.
A particular form of plug switch.

Telegraphs :—

Signaling System, W. E. Decrow, Boston, Mass., 534,364. Filed Dec. 31 1892.
The transmitter is adjustable so that the number of breaks in the main circuit can be varied. At the receiving station a bell is operated or not, according to whether a break occurs during a certain interval of time after the first break.

Telephones :—

Switch Device for Telephone Circuits, C. Clamond, Paris, France, 534,359. Filed July 5, 1894.
An arrangement in which the cut-out switch is located in the receiver instead of being mounted in the transmitter casing; the hanging up of the receiver operates a push switch.

Telephone and Signaling Circuit, F. A. Pickernell, Newark, N. J., 534,373. Filed May 3, 1894.
A trunk line extending between two stations, the two conductors forming portions of the metallic conversation circuit connected with the subscribers circuit, together with an independent instruction circuit including the operator's telephone and an independent signaling circuit, the two conductors of the trunk line constituting jointly the main line of the instruction and signaling circuits.

Electric Signaling Apparatus, J. D. Price, Chicago, Ill., 534,405. Filed May 5, 1894.
By operating a treadle the signal is sent and the receiving circuit cut out; the releasing of the primary actuating medium automatically closes the circuit through the signal, sounds the signal to ring off and opens the receiver. Intended for telephone circuits.

Gramophone, E. Berliner, Washington, D. C., 534,543. Filed March 30 1892.

Telephonic Apparatus, N. L. Burchell, Washington, D. C., 534,547. Filed Sept. 29, 1894.
A telephone of the ordinary type with adjustments to adapt the instrument to persons of different height.

THE CURTIS FACTORY FOR SALE.

In view of the existing low prices for apparatus in the street railway field, the Curtis Electric Manufacturing Co., of New York, is offering for sale its entire property, including patents, factory plant, etc. The patents cover all the features of the admirable Curtis motor, car controller, etc., used with great success on various roads, while the factory has a superb equipment equal to the production of 10 double motor street car outfits per week, day work only. The machinery is of the most modern design and is in excellent condition. The stock in hand includes motors, controllers, rheostats, etc., as well as various supplies. This opportunity is a rare one for any concern desiring to engage in the manufacture of electrical apparatus and wishful of securing an advantageous start. The Curtis Company can be addressed at P. O. Box 412, this city. Its factory is situated in Jersey City close to the Pacific Avenue Station of the Central Railroad.

REMOVAL OF THE CUTTER ELECTRICAL & MFG. CO. PHILADELPHIA.

THE CUTTER Electrical & Mfg. Co., of Philadelphia, have removed to No. 1112 Sansom St. and announce their removal in the following circular :

Again we have been forced by the demands of an increasing business to move into larger quarters. Two causes have been contributory to this condition; one of which was a fixed determination, followed by persistent effort on our part to give to our patrons the highest grade of electrical work possible; the other cause has been the appreciation and liberal patronage with which we have been favored. We appreciate all your favors of the past and solicit a continuance in the future.

FINDLAY, O.—A movement is on foot to build a new telephone line to connect principal oil centres of Wood and Sandusky counties. The proposed line would connect Prairie Depot, Woodville, Bradner, Gibsonburg, Helena, Kansas, and other points which are now inconvenient of access by telegraph or otherwise.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE HOUSTON, STANWOOD & GAMBLE COMPOUND ENGINE FOR ELECTRIC LIGHTING.

THE accompanying illustration, Fig. 1, shows a new type of engine which Messrs. Houston, Stanwood & Gamble, of Cincinnati, have recently installed in the plant of the Wyoming Electric Light, Heat & Power Co., Wyoming, Ohio. This engine is of the cross compound non-condensing throttling type designed to develop a maximum of 240 H. P. with a 120 pound boiler pressure at 133 revolutions per minute.

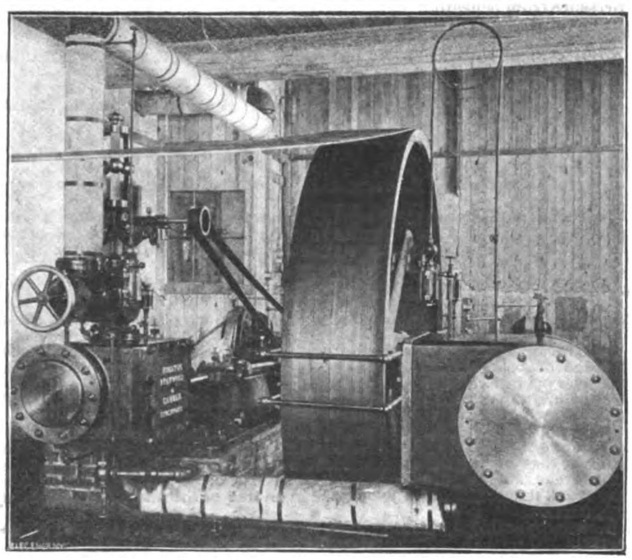


FIG. 1.—THE HOUSTON, STANWOOD & GAMBLE COMPOUND ENGINE FOR ELECTRIC LIGHTING.

The electric light plant at Wyoming is similar to many plants throughout the country in that its minimum load is often one third of the total load. The light loads are on for more than two thirds of the operating period of the station and at present the maximum load is only two thirds of the engine's full capacity; for this reason an engine of the cross-compound type was selected, which is under-speeded 20 per cent.; the engine running now at 112 revolutions, instead of at full speed. This is possible because a cross-compound engine which has a fixed cut-off and throttling governor can be arranged so as to almost evenly divide the work between the high and low pressure cylinders for light and heavy loads. By this means a very even rotative motion is given to the shaft and a fly wheel of moderate weight may be used at low speed to give a steady motion.

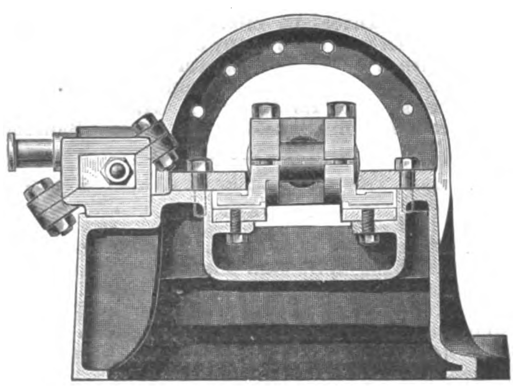


FIG. 2.

As the engine has to operate so much of the time with less than one-half load, the consulting engineer of the electric light Co., Mr. Chas. F. Rice, decided to employ an engine which would show fair economy at light loads, and for this purpose an engine of the compound type with fixed cut-off also seemed most suitable. With light loads an automatic cut-off non-condensing engine operates with so high a degree of expansion, as to expand the steam at the end of the stroke, below the atmospheric line. This of itself is wasteful and the early cut-off also produces excessive cylinder condensation. With the compound engine and a fixed cut-off a degree of expansion can be selected for light loads which will give fairly economical results. The same degree of expansion with heavy loads will be no greater than with an automatic engine, operating at heavy loads. In this instance about 4½ expansions were selected, by which a mean effective pressure (referred to the low pressure cylinder) of 15 pounds has been secured without expanding below the atmospheric line, and a mean effective pressure of nearly three times this amount can be obtained for full load. Under this arrangement the engine now carries a maximum load for three hours of 160 H. P., a minimum load of 50 H. P., and an average load for fifteen hours of 115 H. P. When the increased demands upon the station require it, the engine will be run at full speed.

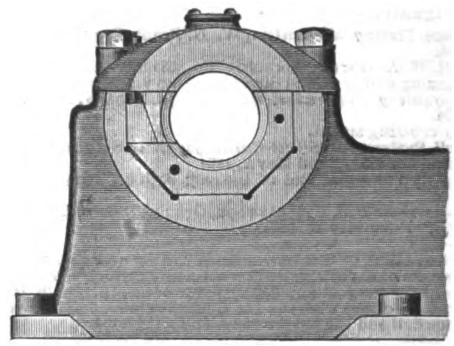


FIG. 3.

The simplicity of mechanism of this arrangement by which simple slide-valves alone are used, makes it very improbable that break downs will be frequent or repairs excessive. In case either the high pressure or low pressure engine is temporarily disabled, one of them may be disconnected and the other operated at one half load under the control of the governor. The losses from leakage are very slight, as slide-valves with fixed travels are the tightest valves made. The danger from water is also reduced to a minimum as slide-valves on the sides of the cylinders give quick and ready relief. For long continuous running these engines are most suitable, as all parts, even the governor, can be kept constantly lubricated.

In regard to design and constructive details, the most prominent feature is the steam jacket around the high pressure cylinder, the object of which is to prevent initial condensation of steam and to heat the exhaust from this cylinder as it passes on into the low pressure cylinder. The receiver space is not very large nor is it steam jacketted; but the steam is reheated by a small jet of live steam taken from the boiler. The arrangement of the jacket and heater are such that there are no traps and jacket pipes to condense steam or to get out of order. Each engine rests upon a cast iron base plate with a flange surrounding its periphery, by which water and oil are prevented from dripping over the foundation. These base plates also serve as cap plates for the foundations.

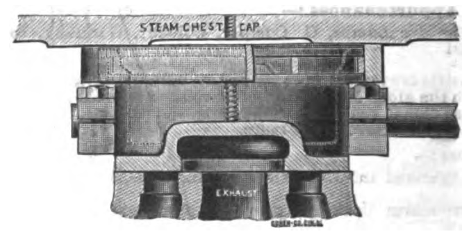


FIG. 4.

The engines have inserted top and bottom slide plates, as shown in Fig. 2, and also inserted main bearings, as shown in Fig. 3, which possess the advantage, that they may be taken out at any time without lifting the shaft and fly wheel. For this purpose, the engines are placed far enough apart so that by slipping the eccentrics back, the bearings may be drawn out laterally toward the fly wheel. The slide valves of both the high and low pressure cylinders are each balanced by a simple ring, as shown in Fig. 4, to about 50 per cent. of their area.

The lubricating devices have been carefully and simply arranged for regular work. The principal wearing surfaces are large and the frame and all details are extremely heavy and strong. These engines are known as the "H-S-G Compounds" and their makers are prepared to furnish any size from 25 to 400 H. P.

THE WAINWRIGHT FEED WATER HEATERS.

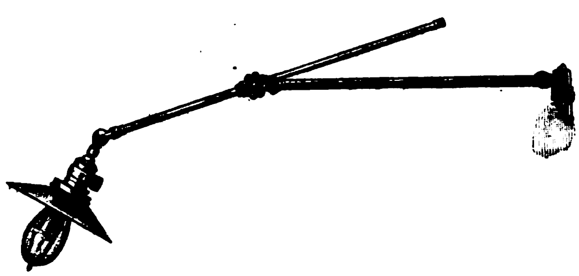
On Saturday, Jan. 26, 1895, a meeting of makers of closed feed water heaters was held at the Astor House, New York, to see if means could be devised, whereby certain abuses which arise from the present method of rating feed water heaters by horse power, could be corrected. An organization was effected and resolutions were adopted, which, on and after March 1st, 1885, bind the subscribers to offer every heater for sale on the basis of the number of square feet of surface contained in the heater, and to show how this surface is calculated, by giving the diameter of the tubing, and the lineal feet thereof, as well as the total number of square feet contained in the heater.

The Taunton Locomotive Works, manufacturers of the Wainwright corrugated copper tube feed water heaters and other steam appliances, have a new catalogue in preparation, which will contain the full details regarding the surface and the method of computing it in every heater which they offer. Until this catalogue is completed, they have instructed their agents to figure in each case the particulars for every style of heater offered, and hold themselves in readiness to answer, by special correspondence, all the particulars, which are not covered by the catalogue which they are now using.

The new schedule of sizes they hope to have ready on or before March 1st, and the new complete catalogue will follow as soon as possible thereafter.

THE WHITE ORNAMENTAL INCANDESCENT LAMP, BRACKET.

The O. C. White Co., of Worcester, Mass., now furnish in fine brass, an ornamental incandescent lamp bracket of new design, shown in the accompanying illustration. It is polished and lacquered, having all the movements of the larger holders, with free and unrestricted movement to any position within its range of 8 feet. It is securely held by tension, easily placed as desired, and there held without difficulty. For desks, offices, libraries, and other exacting service these brackets are said to meet all



White Ornamental Incandescent Lamp Bracket.

requirements in the control of the incandescent light, with or without a shade. They are guaranteed by the company, and are simple in construction, neat in appearance, and capable of long and continued service.

HARRISBURG IDE AND IDEAL ENGINES.

W. R. Fleming & Co. 203 Broadway, New York and 620 Atlantic Ave. Boston, Mass., representatives of the Harrisburg Foundry and Machine Works, have been so successful in the management of the business and territory in their charge that they have been prevailed upon to assume the responsibility of a Philadelphia office and surrounding territory. Mr. David Longenecker of Harrisburgh has assumed the duties of manager for W. R. Fleming & Co. and has leased offices in the Betz Building, Philadelphia. Mr. Longenecker is very well known in the steam and electrical lines, having been for a very long time connected with the outside business of the Harrisburg Foundry & Machine Works, so that it would be difficult to find any one more familiar with, or competent in, these lines of engineering work than he.

THE NEW PYLE ELECTRIC HEADLIGHT.

Mr. George Pyle, of Indianapolis, Ind., the pioneer worker in locomotive electric headlights, has just completed experiments on a new electric headlight for locomotives which he thinks will entirely remove the objections heretofore existing which have prevented its general adoption on railroads. The weight has been reduced three quarters and the price two thirds of the apparatus heretofore employed for that purpose.

Mr. Pyle's engine for driving the dynamo is a compound steam turbine capable of very high speed. It is claimed to be light, compact and simple, there being no valves, joints, reciprocating parts or wearing surfaces of any kind requiring oil, except the bearings which run in oil. The sight feed lubricator in the cab is dispensed with, thereby reducing the running expense to that of the renewal of the carbon, which is 1¼ cents for 200 miles run.

The governor is simple and reliable and is attached directly to the turbine wheel. It is constructed in such a manner as to avoid wearing surfaces, and to run without oil. The steam is used five or six times before it is exhausted into the atmosphere, and its expansive force utilized to the utmost limit. The dynamo and engine frames are cast together and the armature is mounted directly on the engine shaft which runs at 2000 revolutions per minute. Its entire generating plant is only eighteen inches long, fourteen inches wide and fifteen inches high and the combined weight is 200 pounds.

Mr. Pyle claims great advantages for his new lamp for locomotive use. He feeds the carbon in a novel manner without gears or clutches. The lamp and the reflector are mounted on an independent base secured to the sliding lamp board, admitting of proper adjustment and removing the possibility of the rays of light crossing before striking the track.

ENGINES FOR THE NEW LIBRARY OF CONGRESS BUILDING, WASHINGTON.

The following is a list of bidders for engines to go in the new Library of Congress Building at Washington:

The Fischer Foundry & Machine Co.	Pittsburgh, Pa.	$8.468 00
The Buckeye Engine Co.	Salem, O., (informal)	5,200.00
Ames Iron Works	New York, N. Y	6,300 00
George C. Howard	Philadelphia, Pa.	4 500.00
The Ste rns Manufacturing Co.	Erie, Pa.	4,680.00
Morton, Reed & Co	Baltimore, Md	5.700.00
Crook, Horner & Co.	" "	4.687 00
Pierce & Miller Engineering Co.	New York, N. Y.	7,495.00
Justus W. Parker.	Philadelphia, Pa	5,120.00
H. W. Payne & Sons	Elmira, N. Y.	7.2r0.00
Walter L. Clark	New York, N. Y.	3,900 00
Watertown Steam Engine Co	Waterton, N. Y.	4,750.00
W. R. Fleming	New York, N. Y.	6,999.00

The contract has been awarded to Crook, Horner & Co., whose proposal is the lowest which complies with the conditions governing proposals and proffers an engine which is of the specified quality in all respects. These engines, three in number, are to run the dynamos. They are to be 16 in. by 15 in. high speed, horizontal, centre crank, single valve, automatic.

LIGHTING WITH THE SYRACUSE STORAGE BATTERY.

The Syracuse Storage Battery Company have placed a large number of storage battery lighting plants in private residences and public buildings, and are taking up this class of work extensively. In Syracuse, the home of the company, a $6,000 plant is being installed in the building of Dey Bros. & Co., which will be the largest in the country, when completed, and several others are in course of construction in the same city. The performances of the company's storage battery cars. which run from 75 to 125 miles on one charge of the cells, have been commented upon in The Electrical Engineer.

An idea of the satisfaction which the batteries are giving may be gained from some of the testimonial letters received by the company, from which we quote.

The Paragon Plaster Company, of Syracuse, write:

> The storage battery, consisting of twenty-six (26) cells, placed in the Paragon plaster company's mill about two years ago has been in almost constant use and has given excellent satisfaction. We have about fifty (50) incandescent lamps of sixteen (16) candle power, and one arc lamp of twelve hundred (1,200) candle power. The battery handles these with ease. Some of these lamps burn all night. We run our dynamo on an average two afternoons per week for charging. The steadiness of the light is remarkable; there is not the least variation. The battery never fails to work and requires very little attention. No repairs have been necessary, except to change the acid once, at a cost of about $7.
>
> We are very glad at all times to show the battery in operation to any one interested.

Mr. E. T. Hawkins, of Syracuse, says:

> The lighting plant placed in my residence, consisting of 28 accummulators, small dynamo and a three horse power Whitman & Barnes automatic oil engine, is giving entire satisfaction and is doing even better than you said it would. I cannot speak too highly of the outfit.

Mr. W. M. Goodridge, of the Gray National Telautograph Company, No. 80 Broadway, New York city, writes:

> The small storage battery furnished by your company, for use in connection with the Gray telautograph, has given satisfaction in every respect. I have used it for the past four months, and have always found it ready for the work required of it. I shall be glad to recommend it whenever and wherever I can.

The Syracuse Tube Company are agreeably surprised at the working of their battery, and believe it capable of exceeding the company's claims. Their plant consists of 28 "9 C type" accummulators, used in connection with an arc dynamo, producing incandescent lamps at the same time arc lights are burning and also storing enough to run the night lights and office, besides doing away with the necessity of a separate machine for the incandescent lights.

Other letters, all in the same strain, seem to show that the Syracuse storage battery is appreciated and that the company are making excellent use of their opportunities.

HART SWITCHES.

THE Hart and Hegeman Mfg. Co. of Hartford, Conn., have issued their "Catalogue B," a well printed and illustrated pamphlet of 24 pages, containing descriptions of the well-known switches manufactured by the company.

These switches are mounted on porcelain only and the movement is rotary in one direction by quarter turns, keeping the contacts bright and free from dust, and giving the maximum length of break. The make and break are instantaneous, the switch-plates remaining stationary and locked until the handle has been given a quarter turn and the actuating spring has its maximum tension. The actuating spring is of steel wire, and as it is not in circuit, its temper is not affected by the current, which passes between opposite contacts through solid metal and not through pivoted joints. The break is double in all sizes, and in the double-pole switches the circuit is broken at four points. The insulation used is of excellent quality and the workmanship and carrying capacity of every switch is guaranteed.

AN UNDEVELOPED WATER POWER.

MR. L. C. GILMORE, of Independence, Oregon, informs us of an undeveloped water power of 400 H. P. at low water in the vicinity of that town, which promises good returns upon investment. Within a radius of 12 miles are three towns, the smallest with 1200 inhabitants, two flouring mills and a street railway 2¼ miles in length.

ELECTRICAL TRANSMISSION OF POWER IN NEW ENGLAND.

A scheme is on foot to build a dam at Howe's Pond, near Readsboro, Vt., and use the water power there to generate electricity for the neighboring towns. The water will be carried to Readsboro through flumes, giving a head of about 700 feet and the power house will be situated in the village.

It is asserted that C. Q. Richmond, S. Proctor Thayer, W. S. Kelly of Boston, Elmer J. Bullock of Readsboro, Vt., and several others from Boston, have presented a petition before the legislature asking to be incorporated as a company to furnish electric power to North Adams, Mass. It is estimated that at least 1000 horse-power would be furnished to North Adams concerns.

THE ELECTRIC PROTECTION CO.

THE Electric Protection Co., have consolidated with Mr. F. Stevens, and others and are located at No. 1028 Filbert St., Philadelphia. They have a well lighted shop, fitted up with the most modern machinery for turning out work quickly and economically and are now in full operation.

Mr. F. Stevens, who will act as general manager, was with Mr. Edward Weston for 6 years, and subsequently for the space of 7 years superintendent of the Cleverly Electrical Works, so that he comes well equipped to do accurate work. It is needless to say to those who are familiar with Mr. Weston's career and record, that those who have been, like Mr. Stevens, more particularly associated with him in laboratory work, have necessarily to be men of high equipment. They learn to set great store on precision and accuracy, and to be great lovers of detail carried out to the finest degree of perfection. These qualities are exemplified in Mr. Stevens, and will mark all his work under the new conditions.

The Company will manufacture the Plush electric protectors, the Stevens flush switches and do experimental work, adding new specialties from time to time.

NEW YORK NOTES.

THE employés of Messrs. Zimdars & Hunt, electrical engineers and contractors, of 127 Fifth avenue, gave their first annual ball at Lyric Hall, last Friday evening, Feb. 22. The affair was in every way successful and enjoyable.

NEW ENGLAND NOTES.

THE plant of the Ansonia Electric Co. has been sold by order of the Court, to Franklin Farrel of Ansonia, for $41,144. The property was appraised at $65,000. The concern went under when Thomas Wallace & Sons failed two years ago.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have lately completed an addition to the engine room of the Narragansett Electric Lighting Co., at Providence, R. I., and the new plate girder bridge on Laurel street, at Hartford, Conn. The latter is pronounced one of the finest pieces of work in the New England states. It consists of one span 155 feet long, with a road-way 36 feet wide in the clear, and two side-walks, each 8 feet wide in the clear. The road bed is entirely of concrete on buckle plates, no wood work having been used.

THE many friends of the Graham Equipment Company will be pleased to learn that Mr. Granville S. A. Gardiner, the vice-president of the company, has retired entirely from his ticket business in Providence and will devote his attention in future to the sale of the Graham truck. The business of this company has grown to such proportions it was deemed a wise move on the part of the management to secure Mr. Gardiner's entire services. He will spend his time when not on the road between New York and Boston Offices.

PHILADELPHIA NOTES.

LANCASTER PA.—Messrs. Albert and Anthony Iske have invented an automatic break trolley wire hanger which has been successfully tested on the electric street railway lines of Lancaster.

WESTERN NOTES.

THE NATIONAL CONDUIT MFG. CO. have appointed Mr. H. F. Tate western manager, with headquarters at room 542 Rookery Building, Chicago.

MESSRS. J. LANG & CO., Chicago, are busy on some large orders of overhead railway material for the Yerkes lines. Like the well known Lang switches, their railway material is rapidly becoming known as among the best manufactured.

THE HARRISON ELECTRIC CO., recently organized in Chicago, will devote its attention exclusively to the manufacture of telephone switchboards and central office supplies and will not make electrical machinery, as the first reports stated.

MR. M. M. WOOD, the well known electrical engineer and inventor has severed his connection with the Wallace Electric Co. and will hereafter devote his entire time to the manufacture of his many lighting and railway specialties.

THE ELECTRIC APPLIANCE CO. have established the system of profit sharing with their employees, to date from December, 1894, the basis being one-tenth the net profits to all who have been with the Company the full year.

THE METROPOLITAN ELECTRIC COMPANY are sending out circulars advising the trade that they carry in stock the celebrated Hoffman rod polish. The company have found that the Knapp Sellner adjustable desk lamp holder is attracting considerable attention. It is found to be just what is required for desk light.

THE BRYANT ELECTRIC CO. issued a neat souvenir for distribution at the Cleveland convention. It consists of a book of short stories entitled "Stories you have told or heard before." 40 pages. It is a rather unique form of souvenir and those not attending the convention should send two cents for a copy to the Western office of the Bryant Co.

THE Jefferson City, Mo., Light, Heat and Power Company has decided to enlarge by adding to the present plant a 1000 light machine to furnish current for power and light. After the additional equipment is put in the company will furnish current day and night, 365 days in the year. W. W. Wagner is president of the company and Charles E. Hess, secretary.

THE ELECTRIC APPLIANCE COMPANY, Chicago, in some advance sheets of their new issue of catalogue, No. 8, give the complete rules and requirements of the Underwriters International Electric Association. The rules are arranged in pamphlet form and on each page opposite the several rules are marginal references to such articles in their catalogue as will be needed in order to comply with the rules. The idea is a happy one and should certainly enable their customers to choose intelligently when ordering supplies.

BUSINESS with the Metropolitan Electric Company is brightening up and increasing considerably. They are having a great many inquiries for their I. X. L. triple braided weatherproof line wire. Electric light, electric power and street railway, telephone, telegraph, police, messenger and fire alarm service companies and all others interested in the use of insulated wires for overhead or aerial work, and desiring a superior article at a moderate cost, will do well to confer with them. The indications are that the spring and year 1895 business with them will be very large.

THE WESTINGHOUSE MACHINE COMPANY'S steam engines find a market in the remotest corners of the earth. A 150 H. P. compound of the latest type was recently shipped to Alaska. The trade of this company in foreign countries is excellent. Orders having just been completed for three 150 H. P. compounds to Mexico; 200 H. P. compound to Spain; 300 H. P. compound to France; 150 H. P. compound to Buenos Ayres; 300 H. P. compound to Havana, Cuba, besides a number of smaller engines to Russia and elsewhere.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

Vol. XIX. MARCH 6, 1895. No. 357.

THE ELECTRIC ANNEALING OF ARMOR PLATE.

BY

Elihu Thomson

IT is now some time since the application of electric welding was made to projectiles for the purpose of building them up and for producing shells or uniting hardened tips on armor piercing shells, etc. The present statement, however, will refer to the use of electricity in a novel way to render the armor plate more vulnerable, more especially to the drills and taps of the artisan and not to projectiles, that is, to make them workable for the drills and taps when the armor plate is being made ready for placing in position, or after it has been placed in position on a modern war ship. The armor plates as now produced are frequently "Harveyized," that is, provided with a skin of hard steel of greater or less thickness. This coating has been produced by keeping the plate hot in contact with carbon so that the carbon enters the face of the plate, or enriches the face of the plate in carbon, which by a subsequent chilling operation acquires the properties of very hard steel; when struck by a projectile this hardened surface acts to damage the projectile or break up its puncturing end and so prevents entrance into the body of the plate, which is of soft material back of the Harveyized surface. The thickness of the Harveyized chilled coating may vary from $\frac{1}{2}$ to $\frac{3}{4}$ inch, more or less.

While it is possible in producing the armor plate to protect certain areas from carbonization and thereby retain some portions of the face of the plate soft when the armor plate is finished, still it is very difficult to arrange that these soft places shall be exactly where they are wanted, or that they shall surely be in a condition to admit of drilling and tapping.

Soon after the introduction of the Harveyized plates, it became a great desideratum to be able to locally anneal or soften the chilled surface to a depth sufficient to include all the hard steel at any particular point where it might be necessary to drill the plate in assembling it upon the war ship under construction. Various means, such as the application to the surface of the most intense flames of the oxy-hydrogen blowpipe, were found ineffective to accomplish the result desired. The matter coming to the attention of the Thomson Electric Welding Company, was referred to its experts and pronounced by them to be capable of accomplishment by the passage of heavy currents locally through the surface of the plate. A number of experiments with sample pieces of plate did not, however, at first yield the desired results, and it was only by the establishment of a process of working or distinct method that the result could be accomplished. This method was patented to Mr. Hermann Lemp, the electrician of the Welding Company, by United States patent No. 531,197.

The process consists essentially in passing a current between two electrodes placed at a certain distance apart on the plate surface, and thereby heating a portion of the plate to an annealing temperature, after which by a very gradual and careful diminution of the current the temperature is slowly lowered so that the too rapid cooling by conduction of heat to the massive plate back of the heated portion shall be prevented from acting as a chill upon the heated metal. This provides that during the cooling there shall be a constant and continual application of the heating current and the production of heat, but at a rate which is made less and less, so that the metal back of the hardened surface, which is constantly abstracting heat, may be kept supplied, with the result that the fall of temperature at the heated or annealed spot may be controlled and kept such that no subsequent chilling takes place.

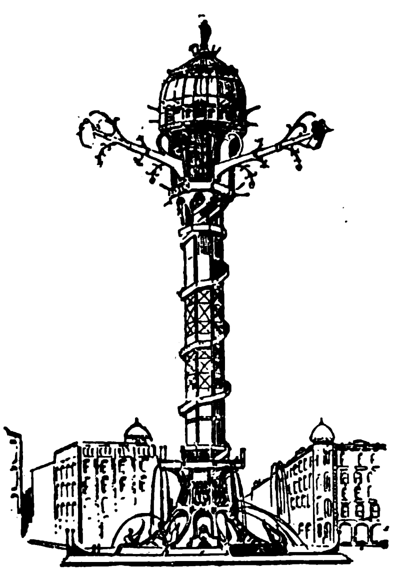
It will be seen that the operation is one of such nicety that it could hardly be expected that the use of the blow-pipe would suffice, first, from the difficulty of supplying the heat to the plate rapidly enough to make up for that which is conducted away into the body of the plate, and at the same time to continue the increase of temperature at the spot to be annealed, while sufficiently localizing the action; and, secondly, from the difficulty of controlling just the degree of heat and the rate of cooling of the metal, which would be required to prevent rehardening. The real object of annealing the spots on the armor plate is, of course, to enable holes to be drilled through the surfaces and screw threads to be cut into them by tapping, so that the plates themselves can be attached, or have other parts of the ship attached to them.

The apparatus used in the practice of the process consists of a dynamo furnishing alternating currents, suitably driven, these currents being such as are used in operating electric welding apparatus by the Thomson process. The currents from the dynamo feed the primary of a transformer, which is, in many respects, the same in general construction as a welding transformer. Instead, however, of the secondary terminals ending in clamps they are simply blocks of copper cooled by water circulation, and separated a certain distance. These blocks are applied to the face of the plate under some pressure and the current passing between the blocks heats up the metal between them, and here, as in certain welding operations, the fact of the use of alternating currents favors the concentration of the heating effect and the flow of current locally. The self-induction effect or reactance is least when the current flows near the surface of the plate between the electrodes, so that any current which branches from the electrodes and enters deeply into the plate not only has a longer path, but has a path in which the self-induction operates to limit the flow.

In actual practice with the apparatus at the Cramp shipyard it has been found that the results are highly satisfactory, the original apparatus being made to do, with facility, work in position and under circumstances which was not contemplated in its original construction, and for which other special arrangements were being worked out. The value of the process was more clearly demonstrated in the case of the warship "Massachusetts," which is under construction, as it was found that certain of the armor plates for the barbettes were hard, or possessed the hard Harveyized skin where it was absolutely necessary that they should be drilled and tapped. Indeed it was

impossible to properly attach the barbettes without making tapped holes in certain portions of these plates. Strenuous efforts had been made to accomplish the result by blow-pipes, and such means did not succeed, while during these trials the building of the upper deck was delayed, and until the proper securing of the barbette plates had been accomplished. On the appearance of the electric annealing apparatus at the yards it was soon turned to the accomplishment of this work for the "Massachusetts," so that there was no further need of delaying the work on the ship from the cause mentioned. There is no doubt that the apparatus and process will soon become one of the necessary features of a modern establishment for the construction of armored vessels.

NOVEL ELECTRIC LIGHT TOWERS IN BILBAO AND CHICAGO.

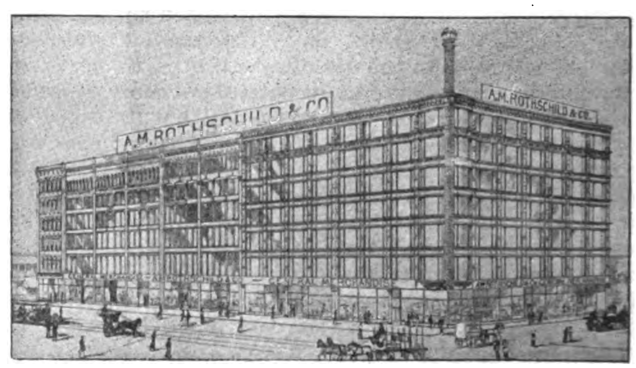


The Bilbao Tower.

The combination of the electric light tower in some form or another with architecture or with special features of decoration is proving very popular and successful. When the arc light tower was introduced many years ago, it was a bare skeleton of iron or steel or even wood; and it has remained grim and angular until quite recently. Then came the utilization of the incandescent lamp for structural effects beginning probably with the Tower at the Philadelphia Electrical Exhibition and reaching its climax in the Stieringer Tower of Edison lamps and the Western Electric Pillar of Fire at the World's Fair. The effect there shown was so pleasing that enterprising people at once saw their way to its use as an advertising feature, and it may safely be said that a great deal of work is now assured in this branch of the art.

As examples of the common tendency in the employment of both the arc and the incandescent light, we illustrate the latest exemplifications of their use in decorative towers. Bilbao, the beautiful capital of the province of Biscay, in Spain, has lately lost its most prominent landmark, the "Arbol de Guernica," the trunk of a tree standing upon the market square for many centuries, until one day a stroke of lightning laid low the giant. To reproduce this landmark and rear a lasting and beautiful monument of Basque patriotic feeling, Don M. Alberto de Palacio, an eminent engineer, has designed a unique arc light tower of iron and glass, which is now in course of construction. The tower adheres in the main to the lines of the old tree. It is shown above in outline. The foundation represents the roots, knotty and protruding from the soil; water surrounds the tree, dolphins, winged monsters and other fantastic figures spout water in all directions; three light bridges across the basin furnish access to the interior, a hall of 60 feet in diameter and 23 feet in height, being on the ground floor At a height of 35 feet another room of 45 feet in diameter is surrounded by a graceful gallery, adorned with the arms of the Basque provinces. Here the trunk of the tree really begins and tapering slightly towards the top it rises to a height of over 120 feet, entwined by a spiral stairway emblematic of the ivy clinging to the old oak. A gallery on top carries a dome representing the crown of the old tree, and several long branches with the arms of the Basque provinces and electric lights. The dome is surmounted by an allegoric statue.

The other example is found in severely modern Chicago and is furnished by a new drygoods store there, which is to occupy the entire block on the east side of State street, from Van Buren to Jackson. This building will be 360 feet long and 45 feet deep, seven stories high, with 252 windows on the front, and fourteen elevators. One of the features will be an immense electric tower on the Van Buren and State street corner which will turn night into day with 2,930 incandescent lights. It will be after the style of the Stieringer tower at the World's Fair and will present constantly varying hues. The trade mark of the firm, which will be an eagle on an electric globe and tower, and the name of the firm, A. M. Rothschild & Co., will take up a space 200 feet in length and 7 feet in height on top of the front and side of the building and will require several hundred electric lights. At night time the interior of the building will be lit up with 480 constant potential arc and



THE CHICAGO TOWER.

2,040 incandescent lamps. It is possible that in the end as many as 1,200 constant potential arcs may be used, replacing some incandescents. The Brush Electric Co. have, it is understood, secured the contract for this unique piece of work.

THE ELECTROLYTIC PREPARATION OF MANGANESE.

At their chemical laboratory at Linden, in Hanover, Germany, Messrs. Konigsmaier and Ebell have undertaken the electrolytic separation of manganese from its compounds. They have succeeded in obtaining the metal in a condition practically pure, in the form of a fine powder. In preparing alloys of the metal, in order to avoid the loss inevitable from this finely divided condition, they use in the crucibles alkaline chlorides and chloride of manganese, which is not subject to oxidation by the air. The processes adopted have been covered in Germany by patents.

GERMANY'S FOUR PRINCIPLES.

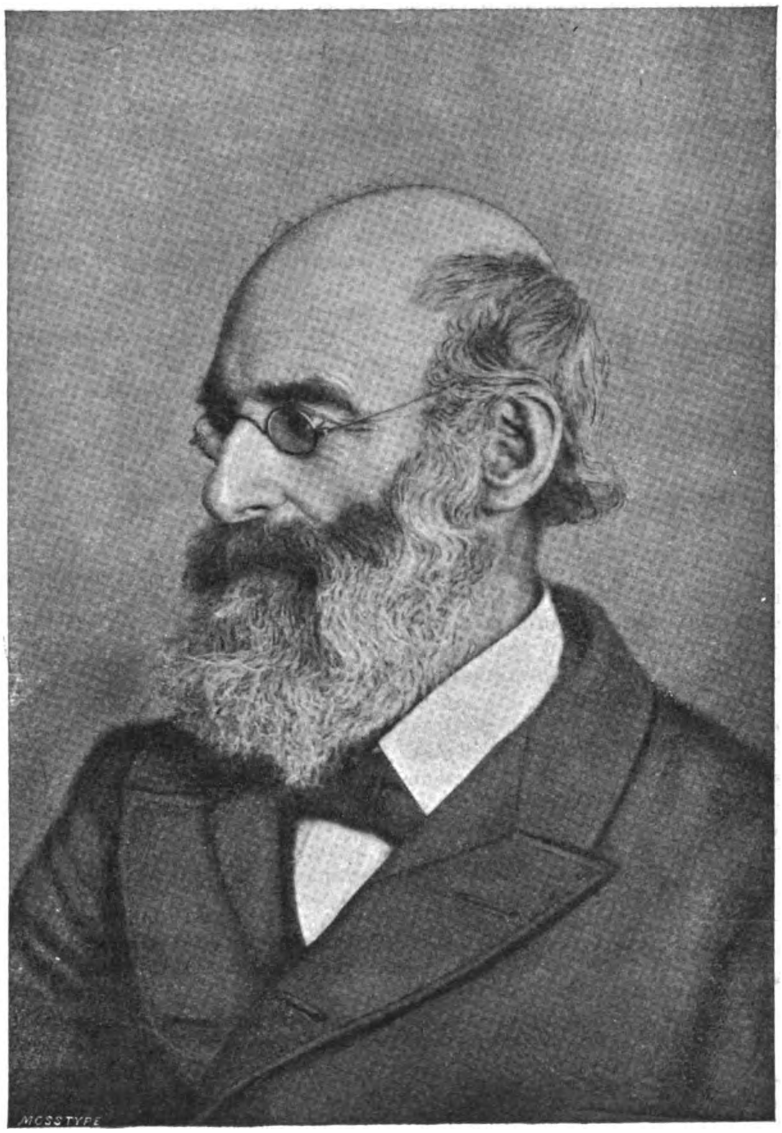
In the course of a review of technical development in the applications of electricity during 1894, the *Elektrotechnische Zeitschrift* states that the use of accumulators in central stations in Germany has greatly progressed. On the other hand, alternating current stations have also been extended; and the four principles—moderate periodicity, large units, slower speed, and direct coupling—have been introduced almost exclusively in German works. Our contemporary states that the rotary current system bids fair to be adopted in new stations in preference to the ordinary alternating system.

ROYAL E. HOUSE AND THE EARLY TELEGRAPH.

BY

Franklin Leonard Pope

ROYAL EARL HOUSE, who died at his home in Bridgeport, Conn., on February 23, at the advanced age of 81, was in many respects one of the most remarkable of the galaxy of American inventors whose achievements have rendered the annals of the nineteenth century illustrious. In the limited space at disposal, it is impossible to give more than the briefest outline of his singularly interesting career. Born in Rockingham, Vermont, September 9, 1814, he removed, while yet young, with his parents to Choconut, a small hamlet in Susquehanna County, Pennsylvania, a point farther remote from civilization at that date than is Alaska to-day. His inventive talent first manifested itself in the construction of a submerged water wheel for a saw-mill, which embodied a principle since used in many forms, and known as the "scroll wheel." Early in the forties, he went to Buffalo, N. Y., with the design of studying law with a relative of his family residing there, but having gained access to a limited number of scientific books, he became interested in electrical researches, and these soon became the absorbing passion of his life. Returning to his home, he conceived and worked out in his own mind, without the slightest knowledge of what had been done by others, the scheme of an electric telegraph. From the outset, his design was to produce a record in printed Roman characters, and all his efforts were devoted to that end. He possessed the unusual and remarkable mental capacity of originating and designing the most complicated mechanical structures, in all their parts, details, combinations and dimensions, without embodying them in models, drawings or other tangible form. In this way he thought out his first printing telegraph, which was adapted to work with two independent circuits one of which was made to turn a type-wheel step by step, while the other served to give the impression of each successive letter then presented, precisely as is done in many of the more recent "stock-tickers." Having fully completed the design in his mind, House came to New York, and had his machine constructed piecemeal at two or three different shops, afterwards assembling the parts together with his own hands. This apparatus was exhibited in successful operation at the fair of the Mechanic's Institute of New York, in the basement of the City Hall, in the fall of 1844, only a short time after the establishment of Morse's first line between Baltimore and Washington, and long before this had been extended to New York. Mr. William Ballard became interested in the invention, and furnished House with the necessary means to perfect the invention. When completed, which was not until several years afterward, it proved to be a perfect marvel of mechanical skill and ingenuity, and was demonstrated to be capable, under favorable conditions, of printing messages in plain Roman characters at the rate of more than fifty words per minute. Capitalists ultimately became interested in the scheme, and between 1847 and 1855, an extensive range of telegraph lines was erected, extending from New York along the seaboard to Boston and Washington, and west as far as Cleveland and Cincinnati, on which the House instruments were employed with great commercial success. Many original details of the line construction were designed and carried out by Mr. House, and, viewed in the light of later knowledge, they stamp him as an electrician whose practical attainments were vastly in advance of his time. He preferred to employ stranded wires of great conducting capacity, insisting that a much higher speed of transmission by his system c uld be obtained in this way than by means of solid wires of equal resistance, a theory which was scouted by electricians for nearly half a century, but which is now universally admitted to be true. He designed and constructed the first successful long span river crossing at Fort Lee, in 1849, carrying two piano wires on masts 400 feet above the Hudson river, in a span of over 4,000 feet; thus for the first time establishing permanent telegraphic communication between New York and Philadelphia. He designed an insulator having a glass screw-socket to engage with a thread cut upon the top of the pole. When the glass manufacturers insisted that it was impossible to make it, he at once designed a machine for



ROYAL E. HOUSE.

performing the operation, which in its essential principle, is in use to this day. By his wonderful powers of observation and invention, he was able to overcome every difficulty as it came up, and no electrical or mechanical problem ever appeared to baffle him. Suits were brought in 1849 by the owners of the Morse inventions against companies using the House machine, alleging infringement of their patents, but the combined technical and legal skill of Counsellor George Gifford, the forensic pyrotechnics of Rufus Choate, reinforced by the consummate expert knowledge of House, himself, were too formidable an opposition to be readily overcome, and in June, 1850, in the United States Circuit Court in the District of Massachusetts, Judge Woodbury announced his famous decision, refusing an injunction; a most notable victory for the eminent inventor and his associates, especially relished by House in view of a remark which had once been made by Francis O. J. Smith, one of the principal owners of the Morse patents, that he could drive his old Durham bull from New York to Boston with a message tied to his horns quicker than it would ever be sent by House's printing telegraph.

After the general consolidation of competitive telegraphic interests which took place about 1860, the House apparatus gradually went out of use, the simplicity and cheapness of the Morse system, and more especially the vast improvement in the skill, rapidity and accuracy of the operators over those of early days, rendering the use of the latter more profitable to the companies. Mr. House himself, in possession of a competency acquired from his invention, removed to Binghamton, N. Y., where he lived in comparative retirement for many years. In 1865 he appeared at the Patent Office with a most elaborate and ingenious system of automatic sound telegraphy, obviously the fruit of years of laborious study, and embodying features which have proved of extraordinary value in other systems of intercommunication, but which, as a whole, never met with the acceptance of the commercial telegraphic interests of the country. About ten years since, he removed to Bridgeport, where he passed the remainder of his days.

Mr. House possessed keen powers of observation, great originality of mind, and extraordinary tenacity of purpose. He was a man of vigorous physique and attractive personality. He was in full possession of his faculties to an advanced age, and retained in his memory the minutest details of his diversified and eventful life. His first patent bore the early number of 1,200. His last was No. 533,600.

REMINISCENCES OF THE LATE RUDOLF EICKEMEYER.

BY

Stephen D. Field

I note in your issue of Jan. 30 a biographical sketch of my late friend Mr. Rudolf Eickemeyer of Yonkers, N. Y. As I have been perhaps more intimately connected with him in various electrical developments than any other person, a word from me may not be out of place.

Mr. Eickemeyer was one of those rare persons whose mind seemed to be capable of grasping a proposition and instantly reducing it to its most economical mechanical solution. It can be said of him that he never produced a failure; everything which he undertook during his long and varied career was carefully worked out before being introduced to the attention of the public and only those who have been his intimate associates can have any idea of the infinite capacity which he had for long and careful investigation of any new problem.

His electrical investigations commenced with experiments on the telephone, his work on this apparatus leading him on to other applications of electricity and eventually to the production of the dynamo and motor to which his name is given. He was one who was always ready and anxious to accord to others all possible credit for their work and when engaged in any particular branch of investigation would not listen to any conversation or read any literature pertaining to what others might be doing in the same field.

A remark made by Mr. Eickemeyer to me one stormy Saturday afternoon is a keynote to the whole character which he possessed. Speaking of his early struggles in Yonkers he said: "We commenced business in 1854. From that time until the present (1890) we have never closed our doors, and a Saturday afternoon has never passed without every workman going home with his wages in his pocket, though the proprietors often found theirs empty."

At another time after a series of experiments extending over a period of about four years he at last had his experimental apparatus completed and working successfully. On the very day which witnessed the completion of the mechanism, the Official Gazette of the Patent Office showed it patented to another person. Mr. Eickemeyer's only remark was "Well! I can certify that —— has a good thing." And that was his character through and through, —perfect justice to all.

Mr. Eickemeyer's loss will be keenly felt in public as well as private life in the city of Yonkers. For years he has been a leading spirit in public affairs, serving in offices to which much work and no remuneration was attached, such as the Board of Education, the Water Board, etc., his sound business sense making him a most valuable member of all public departments with which he was connected.

For many years Mr. Eickemeyer had kept a most elaborate record of all his experimental work, which cannot fail to be of rare educational value. The same sterling, manly traits shown in public were very conspicuous in his private life; his home was an ideal one where, surrounded by children and grand-children he has of late years enjoyed a well earned rest.

MUNICIPAL ELECTRICITY WORKS.

Mr. Max Meyer, of Nurnberg, states in the *Elektrotechnische Zeitschrift* of Feb. 10 that the anticipated surplus of income over expenditure in municipal electric lighting plants has in most cases been realized. In those towns where gas works exist the connections to the electric light mains are somewhat slow during the first year, particularly when the price of electrical energy is high. Consequently a proper conclusion cannot be drawn from the initial year's operations, but the connections increase as the electric light undertaking gives satisfaction to its customers. A table is given below, representing, in percentage of the capital outlay, the surplus of receipts over expenditures during 1893-94, the balance remaining for the payment of interest and redemption. The figure of 4 per cent., as in the case of the Christiania electricity works during the years 1893-94, the author states, is sufficient for providing for depreciation.

	Receipts.	Expenditures.	Surplus.
Altona	12.6	5.56	7.04
Barmen	11.7	4.10	7.60
Breslau	23.98	9.02	14.96
Cassel	13.1	4.1	9.0
Christiania	13 1	4.90	8.20
Dusseldorf	9.92	2.94	6.98
Elberfeld	14.1	6.2	7.90
Neuhaldensleben	19.4	8.2	11.2

A direct proof of the commercial success of central stations, the author concludes, is afforded by the energetic endeavors on the part of promoters to obtain fresh concessions and to carry out electric lighting works at their own expense.

ON THE DELINEATION OF ALTERNATING CURRENT CURVES WHEN THE ALTERNATOR IS NOT ACCESSIBLE.[1]

BY DR. J. A. FLEMING, F.R.S.

After a good deal of experimenting, the writer has succeeded in constructing a simple arrangement which enables curves to be taken with the utmost facility at any place and on any circuit. The principle adopted is a sufficiently obvious one, but the success of the apparatus depends entirely upon the details of construction. The method employed is to construct a small alternating current motor, of a synchronous type, this motor being made to take up as little power as possible and run with the most perfect

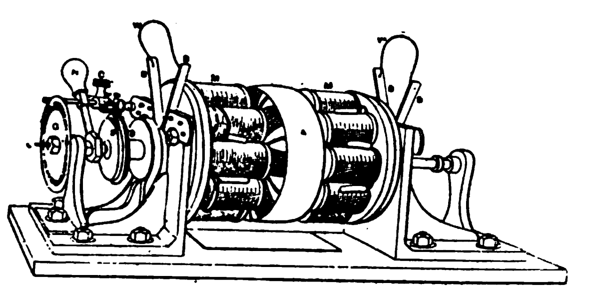


FIG. 1.—FLEMING APPARATUS FOR DELINEATION OF ALTERNATING CURRENT CURVES.

freedom. On the shaft of this motor is fixed a contact arrangement, presently to be described, which contact is made to close a circuit at any assigned instant during the phase cycle, and this instantaneous contact puts into communication the source of alternating electromotive force and an electrostatic voltmeter which is employed to measure the fall of potential down a non-inductive resistance, which is placed either across the supply mains or in series with them. The general details of the machine are as follows, a sketch of it being given in Fig. 1.

The motor part consists of two sets of field magnets, M M, which are secured to two cast-iron discs. Between these field magnets revolves a small armature, A, the iron core of which is formed of a strip of very thin transformer iron, wound up into a ring, the armature coils being wound upon this ring. The armature coils are joined up in series with one another, so as give a series of contrary polarities round the iron ring. The diameter of this armature is about 6 in. The field magnets have eight poles, and the armature eight coils. The field-magnet cores are bobbins about 2 in. long, and 1½ in. in diameter, and when joined up in series in the proper manner the field magnets take a current of about four amperes to give them the proper amount of saturation. The armature is carried upon a hard wood boss fixed to a steel shaft. This steel shaft is carried through small ball bearings like bicycle bearings, the shaft being borne upon seven or eight balls carried in gun-metal cells. In order to prevent any side shake of the armature, there are at the opposite ends of the base cast-iron pillars with a gun-metal screw at each end, against which the rounded end of the shaft bears. The shaft can thus be adjusted with great nicety, and runs with great freedom from friction. The ends of the armature coils are brought to two small insulated collars, fixed on the shaft, against which press two light brass brushes, marked B B, kept gently against the collars by means of an expanding steel wire, W. On the armature shaft is an ebonite disc, which carries a transverse steel slip let into it. Two insulated springs, S S, are carried upon a rocking arm, H; the rocking arm can be traversed over through half a circumference, and is centred upon the gun-metal end screw which prevents side shake in the shaft. A pointer and graduated scale, G, enables the exact angular position of the springs, S S, to be determined. One of the springs, S, is carried on a small adjusting screw, so that one spring can be given a little lead over the other, and in this manner the duration of the contact made when the steel transverse piece passes underneath and electrically connects the springs S S is determined. By means of a set screw the springs can be lifted off from the ebonite disc, and their pressure also adjusted.

This little synchronizing motor with its attached contact-breaker forms the apparatus for determining the form of the current and electromotive force curves. The motor is started in step with the alternating current flowing through the armature coils by passing round the end of the steel shaft which projects at the end opposite to the contact-breaker a tape or thin leather strap sprinkled with rosin. To start the motor the following arrangements are made: The field magnets must be served with about four amperes of current, which may be obtained from a small secondary battery, or from any other constant source of continuous current. The armature circuit requires about two amperes to make it run properly. Let us assume that the curve of electromotive force is to be taken from two 100-volt alternating current mains which come into a building. The armature of the motor is joined across these mains in series with two or three incandescent lamps placed in parallel. The field magnets being excited in the proper direction, the operator passes the strap or tape half round the shaft, and by pulling on one side of the tape the motor can gradually be set in rotation with an increasing speed. If the frequency of the alternating current is, say, 100 ~, then the motor has to be brought up to run at something approaching to 1,500 revolutions per minute before it will drop into step, but at a certain speed the incandescent lamps in series with the armature begin to blink, and by a little skill in adjusting the speed by suitable pulls on the tape the motor will drop into step and continue to run in synchronism with the circuits. If the springs are then put down gently upon the revolving contact piece, a contact is made from one spring to the other at an assigned position during the phase of electromotive force, depending on the position of the rocking arm. If the maximum pressure to be read does not exceed 160 volts, then by far the most convenient instrument to employ for reading the pressure, and the one which has been constantly employed in these tests, is Lord Kelvin's vertical or horizontal pattern of multicellular voltmeter. As these voltmeters only begin to read at about 60 or 80 volts, it is necessary to add a constant electromotive force in series with them, and this is done by employing a set of small lithanode secondary cells. About 50 cells in one tray form a convenient arrangement, provided that they have contacts at every cell, so as to take off any required electromotive force. The battery is joined up in series with the electrostatic voltmeter, and the terminals of the voltmeter are short-circuited by a condenser having a capacity of about half a microfarad.

This arrangement of voltmeter and battery is then connected across the two points between which the potential is to be determined through the two springs S S. The motor being started, the needle of the voltmeter takes a certain deflection which is due to the electromotive force of the cells, plus the value of the difference of potential between the mains at an instant depending upon the position of the rocking handle. By blocking up the voltmeter in this way, and using more or less cells as required, so as to add a known amount to the electromotive force to be measured, the electrostatic voltmeter can be employed to measure potential differences over the whole range varying from zero to 160 volts in either direction. These observations are taken at equal short intervals as the rocking arm H is swept over through a quarter of a circle. It is possible to thus measure the instantaneous values of the alternating potential difference between the two points at equi-distant instants throughout the phase. It has been found by experiment that this small alternating-current motor, when working on the circuits of any alternator of a size such as would be used in a generating station, does not affect the form of the

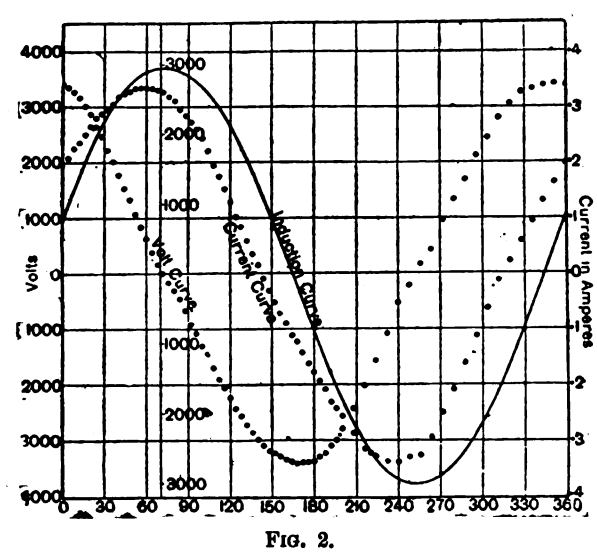


FIG. 2.

curve of electromotive force sensibly. The motor is only used as a means of making the contact with a voltmeter at an assigned instant during the phase, the current which passes through its armature is not in any way measured or taken account of; the motor simply acts as a synchronizing arrangement, which connects the contact-breaker *electrically* to the distant alternator. A large number of experiments were made with this curve tracer in the electrical laboratories at University College, London. After having satisfied doubts that might exist as to the ability of the curve-tracer to give a curve identical with that obtained by a contact-breaker actually upon the shaft of the alternator, the

1. Abstract from the London *Electrician*.

curve-tracer was employed to delineate the curves of primary electromotive force and primary current of a Ganz 10-H. P. transformer worked off a Kapp alternator, and these curves are shown in Fig. 2. From the curves of current and electromotive force the curve of magnetic induction could be calculated. The dotted curve marked *volt curve* is the curve of primary electromotive force, or difference of potential at the terminals of the transformer. The dotted curve marked *current curve* is the curve of primary current, and the dots show the actual position of the observations. The figures on the horizontal line indicate degrees of phase. The scale on the left-hand side is the scale of volts, and that on the right-hand side the scale of current. The full line curve is the curve of magnetic induction, and the middle scale is the scale of C. G. S. units representing induction density, or "number of lines of force per square centimetre" in the core. From the curves of induction and current the magnetic hysteresis curve was drawn, and the whole in the diagrams of the transformer thus obtained without access to the alternator at all.

Curves of groups of alternators working single or in parallel or on non-inductive water resistance and also on the ordinary station load have been determined, and these curves form an exceedingly interesting addition to our knowledge of the form of the curves of electromotive force taken from different machines in different states of load. They show how widely different are the forms of the curves from different machines, and how much variatiations of the load may affect the form of the curve of electromotive force.

One question has received solution. The iron core losses have been taken of a transformer when working off two different alternators, and the curves of electromotive force of these alternators also taken, and it has been found that the iron core loss in the transformer is least when taken on that alternator the E. M. F. curve of which is farthest removed from being a simple sine curve, a result in contradiction to some statements made not long since.

NOTES ON RECENT ELECTRICAL ENGINEERING DEVELOPMENTS IN FRANCE AND ENGLAND.[1]–I.

BY H. WARD LEONARD.

Introduction.—As a result of inspecting some of the most interesting of the developments in the field of electrical engineering during a recent trip to France and England, and as a result also of having met many of the engineers responsible for these recent developments, I find it difficult to reach a conclusion as to whether we or our contemporaries across the water are ahead in the electrical engineering race. Of course when one attempts to compare the electric developments of the respective countries commercially, we are in the same position as the "America" was in the historic yacht race, "there is no second"; but considering the recent electrical development from an engineering standpoint we are rapidly losing the lead we have thus far held.

Although I have always felt that so-called fundamental patents and the resulting enormous aggregations of capital and engineering talent under one management were a millstone around the neck of our profession, I have never before had the opportunity of seeing positive and unmistakable evidence of it such as this visit abroad showed me. In the beginning of electric lighting, both arc and incandescent, we led the world from an engineering standpoint, and were years ahead of any other country. But what has been done in this country in the way of a remarkable electrical engineering development since Edison started his first three-wire system at Sunbury, Pa., in July, 1883, and Westinghouse established his alternating system with 1,000 volt primary and 50 volt secondary a few years later, and Sprague started the Richmond electric road? A moment's thought will, I think, make you all realize that the practical development of electrical engineering improvements is almost impossible against the opposition of the gigantic corporations in that field, and that corporations having such a large portion of their capital represented by patents will not wish to see the practical trial of a promising improvement which they do not control, and which may depreciate the value of the methods they control or claim to control. It is in just this way that we are losing ground when compared with England and France. We undoubtedly have the best three-wire central station plants in the world, also the best alternating system converting from 1,000 to 50 volts. But what other kind of central stations have we to point to? Practically none.

We have 500-volt continuous current electric railways galore, and we operate such railways at distances for which 2,000 volts should be used instead of 500, and after investing more money in copper per car than the entire cost of the electrical equipment, we still lose twice as much energy as is commercial in the line. Is there a large electric railway system in this country which as an electrical transmission of power is a credit to our profession? Not one.

In France, and even more in England, one is forcibly impressed by the many kinds of central stations being tried. Many of them may seem almost sure to prove commercially unsuccessful, but who can say which one may not prove the "Sunbury" of an enormous electrical engineering development?

No capital or patents can prevent the slow development of evolution, but I fear that under the existing conditions we shall have to content ourselves with drawing pictures of what might be done, and watch the continued introduction of the three-wire system of 1883, the 1,000 to 50-volt alternating system of about 1887 and the continuous current 500-volt railway system of 1887, while our engineering friends abroad keep trying not only their own ideas, but the ideas of many of us from this side because they have the necessary encouragement and opportunity to do so, while we have not. I have learned on this hurried trip abroad of many applications of inventions of American engineers which have proven very successful and which although patented, described and advertised in this country, were taken up first by English or French engineers notwithstanding their well known prejudice against American inventions.

Alternating Current Practice.—In England one of the first things which impresses an engineer is the total absence practically of a 50-volt secondary for alternating systems. It is the general practice in England of late to use a three-wire secondary with 100 volts on each side. I believe that every engineer who has ever given the subject a thought, knows that there was no excuse except patents for a 50-volt two-wire secondary originally, and no excuse except the inertia and prejudice of large corporations for continuing to put in the two-wire 50-volt secondary today.

Manufacturing and Engineering.—In England there is a multitude of medium size concerns, manufacturing electrical apparatus, and the competition is mainly on ideas, and not the cost of dynamos per kilowatt. It is surprising to find that generators and motors are much cheaper in the United States than in either England or France, notwithstanding their advantages over us as to cheaper raw materials and labor. The manufacturers abroad generally consider the consulting electrical engineers as entirely unnecessary in view of the multiplicity of schemes which every plant brings forth from the various manufacturers, but I believe that a great deal of benefit has been and is being accomplished in England, by virtue of the custom of placing in the hands of good consulting electrical engineers the design, for instance, of a large central station plant to be built by a city itself.

Has a central station of this kind ever been built in this county? I think not; that is, a central station built according to advice from a good consulting engineer who was free to select the good features and eliminate the bad features of the various systems known to the art. Imagine a central station combining apparatus and methods of the General Electric, Westinghouse, and Siemens & Halske all in one system, also taking advantage of other good ideas from the United States and abroad. Who can doubt that it would be better than could be built by using only the patents and apparatus controlled by some one company.

Many will answer that all the best engineers are in the employ of the leading companies and the consulting engineers available are incompetent commercially, and there is a great deal of force in this argument; but even if true, it certainly merely emphasizes the difficulty of getting a practical trial in this country of promising ideas in the electrical field unless they be controlled by one of the would-be monopolists.

Rotary Transformers.—Rotary transformers are used in several stations in England for a continuous current high potential multiple arc distribution, the secondary being a three-wire system as usual. Such a plant is in use at Oxford. At Brighton and several other places the standard 220-volt continuous current three-wire system is supplemented for distant lighting and in newly occupied territory by the alternating system using about 2,000 volts in the primary, and a 220-volt three-wire secondary. This alternating plant supplies the distant and scattered lighting during the period of heavy load, and during the period of light load (about three-quarters of the whole time) this distant lighting is supplied directly from the 220-volt three-wire system by switching the secondary circuit from the converter to the regular three-wire system. Mr. Arthur J. Wright who installed this system first at Brighton, spoke of it to me as an American invention not patented in England, a description of which he had read in the American electrical journals, and was much surprised to learn that none of the central station companies had made use of it in the United States, as it was proving of the greatest value to him in his plant.

Steam Engines.—I believe we are ahead of England and France in the designing of dynamos and engines. Their workmanship leaves nothing to be desired, but giving consideration to amount of material used, efficiency and design, I think we are in advance of them.

One of the most surprising things to me was to see the almost universal use of engines which we would consider had practically no governor. That is, engines using slow acting throttling governors instead of the triumphs of engineering skill which are so common in this country. Not since 1883 have I seen such poor governors as I found generally used abroad in the finest and most recent stations, and upon engines which are almost perfection itself as regards manufacture.

1. Abstract of a paper read before the American Institute of Electrical Engineers, Feb. 27, 1895.

The Parsons Steam Turbine.—The Parsons steam turbine was one of the most interesting things I saw in England. These steam turbines are direct coupled to dynamos, and in sizes of 350 K. W. revolve at 3,000 revolutions per minute, and of course run at higher speed in smaller sizes. The space occupied by a 350 K. W. outfit is over all about 25 feet long, five feet wide and about seven feet high. These turbine plants when running at these high speeds are entirely free from vibration and are not even bolted down, but are supported by three pedestals, one near each end and one at the middle. There are some seven or eight bearings all in line, and a continuous stream of oil is forced through the bearings by a small pump driven by a worm on the main shaft.[2]

Tests by Professors Ewing and Kennedy indicate that this turbine when in perfect condition has an efficiency of one K. W. hour in electrical energy produced by 28 lbs. of feed water, the turbine being operated condensing. This is equivalent to about 15.7 pounds of water per indicated horse-power per hour, and I understood that in a recent competition a guarantee was made by Mr. Parsons which was equivalent to about 13 pounds per indicated horse-power per hour, and that his guarantee was lower than that of the best triple compound condensing engines of the reciprocating type which were in the competition. At Newcastle-on-Tyne I saw a central station of about 25,000 lights operated solely by these steam turbines, and which has been in operation since 1890 and has been earning and declaring dividends ever since it started. An interesting fact as to this Newcastle station is that all of the conductors are laid underground and consist of vulcanized rubber cables drawn into cast-iron pipes which are gas and water tight, and through which chemically dried air is forced from the station by a blower.

There are over six miles of piping and over 25 miles of cable, and after five years' operation Mr. Parsons states that they have not had a single instance of failure of insulation, explosion or other trouble with the underground system.

The Laval Steam Turbine.—Before leaving the subject of steam turbines, I will describe the Laval steam turbine of which I saw a number in the works of the manufacturers, Breguet & Co. of Paris.[3]

A careful test made at Stockholm in 1893, showed an efficiency of 20 pounds of water per horse-power hour with steam at 113 pounds initial pressure and used condensing. The weight of this turbine is about 30 pounds per horse-power in a size of about 30 horse-power. The simplicity of this steam engine, also its theory and practical design in detail are most beautiful, and it seems likely to become an important factor in the electrical field. What is needed is a generator of electricity directly driven by, or preferably constituting a part of, the revolving disc, and here is food for considerable thought.

Five Wire System.—At Manchester I saw the five-wire plant designed by Dr. Hopkinson and recently installed. I inspected the central station for a few minutes only, as unfortunately those most familiar with the principal features of the system were absent at the time of my visit. The dynamos were bipolar machines driven from vertical engines by means of link belts with idlers. I cannot say that I was favorably impressed with the generating plant or distribution system, as far as I could judge of them in such a brief observation.

Liverpool Electric Railway.—At Liverpool I investigated the overhead electric railway. The overhead structure, the motors, methods of collecting the current, etc., were exceedingly well designed and constructed, and gave evidence of good working. The central station apparatus and design was not, however, up to the standard of work here in recent electric railways.

English Central Stations.—In London I visited several central stations of which I will mention two. The first is that of the Metropolitan Electrical Supply Company. This company has an enormous area allotted to it. I will explain right here that both in London and Paris the authorities follow the plan of granting to several different central station companies—supply companies as they term them—the exclusive right to a certain section of the city. No such company can run into any other company's section. At the central station of the Metropolitan company, I found four Parsons steam turbine units of 350 K. W. each, running at 3,000 revolutions per minute. These steam turbines had been in operation only a short time when I saw them, and had been installed for the reason that the central station had been enjoined by the courts from operating the reciprocating engines formerly in use because of the vibration they caused. I was informed that the vibration was particularly troublesome and difficult to overcome, because the central station was built upon made land, above the bed of a former river and that the ground was boggy and transmitted any vibration in the most surprising manner. I inquired as to the working of the steam turbines and was informed that they were not able to detect any difference in their coal consumption compared with the compound condensing reciprocating engines formerly in use. I found that an accident had happened to one of the steam turbines by which it had lost all of the blades in one of the three chambers, which reduced its capacity and efficiency considerably, but did not put it out of service entirely.

The other London central station I shall refer to, is that of the City of London Company. This company supplies the heart of London, that is the old "City of London," which is without doubt the best central station territory in the world, on account of the wealthy nature of the customers, the substantial character of the buildings, and especially because of the peculiarly dismal foggy weather in London. While I was there, artificial light was required almost as much by day as by night. This central station is beautifully located on the south bank of the Thames, near the centre of lighting, and is a fine example of the best that can be done to-day with the alternating system under such conditions. I do not believe it would be possible to find less excuse for the use of the alternating system than in this station, and yet I expect it will pay, for it can hardly fail to earn money under such extraordinarily favorable conditions for lighting.

But I need hardly say that they have no motors except toys, and but few of them; and when I remember that in Chicago 40 per cent. of the connecting load is motors and that this percentage is rising all the time, it seems evident that the City of London Co., is terribly handicapped by the use of the alternating current. However, they have a 2,000-volt primary and a three-wire secondary on each side, and operate the dynamos all in multiple-arc which is certainly using the alternating current to the best advantage. Aside from the use of the alternating current under these conditions, it is difficult to say anything in criticism of the central station. The plant is arranged on the panel system, which Mr. Mordey says originated with him, and which is thoroughly carried out in this station, for each panel or section across the building comprises an independent unit including a boiler, engine, dynamo, and switchboard for 500 K. W. The engines are vertical and direct-coupled to the Mordey alternators. The switchboards are entirely novel in design, being cast-iron pyramids about ten feet high, standing clear from the wall and having all of the conductors inside, with the instruments, etc., mounted on the front face. While very finely finished and ornamental, I could not but think that the vital parts would be more difficult to inspect and repair in case of emergency, than in our recent switchboard practice.

One detail of electrical construction in which the foreign practice seems very backward is the rheostats. In this magnificent station in the City of London, for instance, and in many other places I saw rheostats made by winding german silver wire on a slab of slate, which was then mounted on insulators horizontally on a table, and a slider arranged to move over the surface of the resistance wire itself, which was thoroughly exposed. Another detail in which we are certainly in advance of foreign practice is our instrument work, for which we must thank Mr. Weston solely. I saw many fine instruments while abroad, but they seemed to be more suited for a physical laboratory than a central station; the substantial compact permanent features of the Weston instrument, with its readable scale and dead beat index were conspicious to me by their absence.

French Central Stations.—In France the most interesting central station I saw was in Paris where I visited a sub-station designed for a capacity of 30,000 lights. The sub-station was supplied from a distant central station by means of a constant current of 250 amperes, all devices on this current being in series and the total E. M. F. running as high as 6,000 volts at times.

In the sub-station were rotary transformers, the primary ends of which were series wound motors and all being in series. The secondaries of these rotary transformers as generators, fed a five-wire system of conductors, and in multiple-arc with these generators across the five-wire system, was a bank of storage batteries. The lamps used were 110 volts; some of the rotary transformers had 110-volt secondaries, four of such secondaries being in series so as to make the five-wire system complete independently of the batteries. Other of the rotary transformers had 440 volt secondaries and fed the outside conductors only. On each rotary transformer was a rheostat which was in multiple with the series wound field and which by a step-by-step movement similar to that of the old U. S. automatic regulator, controlled the strength of a series field so as to keep the E. M. F. on the secondary constant; the controlling magnet of the automatic being across the secondary of constant E. M. F.

The storage battery plant was well designed and seemed to be in good order. It was as clumsy and seemed as full of troublesome possibilities as those we have on this side of the water. It had capacity for 8,000 10 C. P. lamps for three hours and cost about $80,000, weighed about 400,000 pounds and occupied a space about 83 x 50 feet. This cost means about $107 per K. W. of output which seems a pretty high price to pay for a plant to generate electrical energy to-day, especially when it probably has an efficiency at three hours' discharge not above 60 per cent. Such a storage battery must be compared in cost with the cost of boilers, engines and dynamos per kilowatt, which would cost perhaps $50 per kilowatt, and whose efficiency would be 100 per cent. as compared with the 60 per cent. efficiency of the storage battery, since

2. For a description of the Parsons steam turbine see THE ELECTRICAL ENGINEER, Nov. 30, 1892.

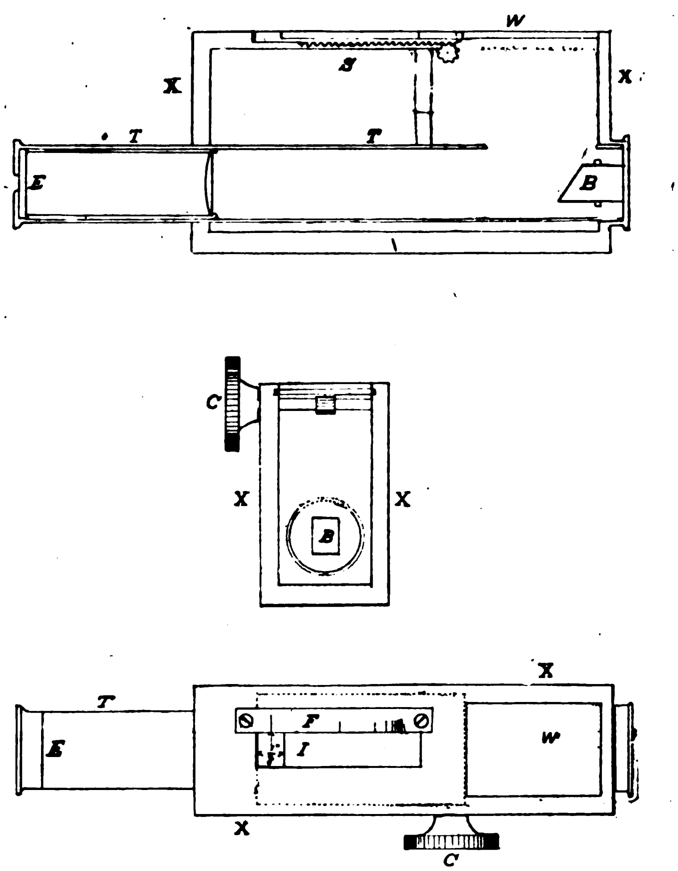
3. For a description of the Laval steam turbine see THE ELECTRICAL ENGINEER, Dec. 6, 1893.

the storage battery must derive its energy from a steam plant first. The craze for storage batteries as the universal panacea for electrical troubles which we have all read so much about in connection with European practice, seems to be on the wane, if I may judge from the statements of the engineers, rather than the storage battery manufacturers, but when we remember that in France and England they do not know what a healthy motor load means, we need not be surprised at the claims of inefficiency for stations which do not use batteries, and hence run their boiler, engine, and dynamo for most of the 24 hours practically without load.

A NEW METHOD OF MEASURING ILLUMINATION.[1]

BY PROF. EDWIN J. HOUSTON AND A. E. KENNELLY, F.R.S.

In practice it is the illumination rather than the luminous intensity of the sources, which is desired to be obtained and measured. The question, as to whether or not a certain area is properly lighted cannot be decided so accurately from the number and grouping of luminous sources and their candle-power, as it can from a method of actually measuring the quantity of light received per unit of area by a particular surface or surfaces whose



FIGS. 1, 2 AND 3.—HOUSTON & KENNELLY'S ILLUMINOMETER.

illumination it is desired to know. In other words, the question at issue is not so much the photometric intensity of the sources of light and their distribution as it is the degree of illumination actually produced, and this question cannot be decided by the photometer, but requires the use of an illumination measurer or illuminometer.

So far as we know there is no actual apparatus in existence, other than that we are about to describe, that will directly measure the intensity of the illumination at a given point, except the portable photometer of Prof. Weber, described by Mr. Heinrich at p. 422, Vol. XI, No. 7, July, 1894, of the *Proceedings* of the American Institute of Electrical Engineers. In Weber's photometer the illumination received upon a screen from a small standard amyl acetate or benzine lamp is compared with the illumination to be measured. The difficulty of obtaining a reliable portable standard lamp, the rather cumbersome size of the apparatus, and the fact that it does not obviate the difficulty of comparing illuminations of different colors, have led us to devise a new instrument based on entirely different principles. We call our instrument an illuminometer.

A certain intensity of illumination is required to render a definite object viewed at a definite distance clearly delineated to the eye. It is well known that the illumination received upon a printed page of a book or newspaper must have a definite value in order to render the printed characters legible, and that the intensity of the illumination so required will, for a normal eye, depend upon the size and character of the print.

We employ this principle in the operation of our illuminometer as follows: A small test object, of, say, printed characters, is placed in a darkened box, sufficiently small to be readily carried in the pocket. The test object is exposed to illumination received from a translucent plate of porcelain or opal glass, which receives directly on its surface the illumination whose intensity is to be measured. Since the test object receives the light from this plate by transmission and subsequent diffusion, it is the area of the translucent plate exposed to the test object in order to just render the latter legible to the eye, that determines the intensity of illumination upon the plate. A focusing eye-piece is placed opposite the test object for purposes of annulling the effect of any focal abnormalities of vision. A sliding shutter movable by a milled headed screw, permits the effective area of the opal glass plate to be reduced until the amount of light received by the test object just permits of its legibility.

The detailed construction of our apparatus will be understood from an examination of Figs. 1, 2, and 3, which represent, respectively, a longitudinal cross section, a transverse cross-section and a plan view. A box X X, blackened inside to prevent the reflection of light, is provided with a tube T T, as shown. The test object is placed on a block at B, opposite the focusing eye-piece E. At the top of the box is a window W W, closed by a translucent diaphragm of porcelain, opal glass, or similar material. This diaphragm is placed so as to act as a secondary illuminator of the test object at B.

In order to regulate the amount of light which passes from the window W W, to the test object, a sliding shutter S, operated from beneath by a milled headed screw C, is placed in guides beneath the window, so as to cover any desired fraction of its surface. In order to determine the effective area of the window, that is, the uncovered portion which admits light to the test object B, the index I, attached to the shutter, moves over a calibrated scale F, from which the amount of illumination on the window W W, may be immediately read off in suitable units.

Calibration of the instrument is effected by exposing the window W W, to known intensities of illumination in a photometer, or darkened room, and marking off upon the scale S, the points at which the indications of the instrument are obtained.

In employing our instrument for such a purpose, for example, as measuring the illumination upon the surface of a table illumined by daylight, candle-light, or incandescent light, we place the illuminometer upon the table with its window up, so that its window being only two inches above the table practically coincides with the surface whose illumination is to be measured. The eye is then applied to the eye-piece and the test object focused under the full illumination. The shutter is then gradually moved over the window until the test object just remains legible, when the number of luxes[2] in the illumination of the table are shown by the index on the scale. The mean error of a single observation with our instrument is about ten per cent.

In the instrument exhibited, the graduation of the scale extends from four luxes, by single luxes to 15, then to 35 in divisions of five luxes, then to 70 in divisions of 10 luxes, while the highest reading is 400. The total length of the scale is 1.5 inches. The total length of the instrument is 5¼ inches, its breadth is 1.5 and its height, excluding the milled headed screw, is 2¼ inches, so that the apparatus can readily be carried in the pocket. Its weight is 10 ounces.

It is known that an illumination of five luxes is sufficient to permit the reading of ordinary print, although, on physiological grounds, the eyes should not be used for continuous reading at illumination less than 10 luxes. Fifteen to 25 luxes may be regarded as proper artificial illumination for reading. In the same way, the amount of light required to permit the performance of other kinds of work is readily determinable. It is evident, therefore, that our illuminometer is applicable to the determination of the question as to the whether the illumination of a given area, is or is not sufficient for the character of work to be done, and that the measurement of illuminations can be made with a reasonable percentage of error, for all intensities within the range of the apparatus. This range can be varied by altering the character and dimensions of the window, as well as the character and dimensions of the test object.

It will be evident that the advantage of such an instrument consists in the fact that it entirely dispenses with the necessity for the use of a portable standard of light, thus removing a constant source of unknown error in apparatus previously employed for this purpose. Moreover, the instrument does not require any great skill in its use, and with simple directions for use, can readily be employed by an inexperienced observer.

1. Abstract of a paper read before the N. E. L. A., Cleveland, Feb. 19-21, 1895.

2. Approximately 1 lux equals the illumination produced by a standard British candle at a distance of a metre.

TELEPHONY.

THE GERST-PERSONS TELEPHONE BILL.

THERE was a hearing at Albany on Tuesday Feb. 19 before the Senate Committee on Cities and the Assembly Committee on Gas, Water and Electricity on the above bill, which proposes to fix telephone rates for New York State at sums ranging from $78 per year for cities of one million inhabitants and over, down to $27 for places of less than 8,000 inhabitants. Arguments against the bill were made by Gen'l. Benjamin F. Tracy for the Metropolitan Telephone Company of New York, the Hon. John Milburn for the Bell Telephone Company of Buffalo, the Hon. E. F. Babcock for the New York and Pennsylvania Telephone Company and Mr. H. S. Snow for the New York and New Jersey Telephone Company. Gen'l. Tracy said that only about one-half of the New York subscribers paid the flat rate of $240 which was made the basis of all the attacks on the company; other subscribers paid lower flat rates down to $150 and there were over 2,000 subscribers who pay according to service rendered and 1,100 public stations that do not yield an average subscription and many of which are operated at a loss. The rate of $78 which the bill would allow to New York was barely half the average cost of operating a subscriber's station. Under the bill a flat rate was imposed whereas the company had many subscribers on message rate basis and this method of paying for telephone service was generally appreciated by the subscribers. The company had incurred great expenses in taking down its overhead system and putting down underground wires, making its system a complete metallic circuit system thus bringing the long distance lines to every subscriber. For the past four years no dividends had been paid, but all surplus earnings had been invested in the plant. No such large profits as had been represented are possible for the working expenses are over eighty per cent. of the gross receipts. Gen'l. Tracy also criticised the bill from a legal and constitutional standpoint and urged that the working provisions for giving it effect are wholly impracticable. From all points of view it would work great injustice to the telephone companies.

Mr. Simon Sterne, the author of the bill, admitted that the criticisms of the counsel for the telephone companies were well founded and asked for an adjournment in order that he might amend the bill. The hearing was adjourned to Tuesday, March 5.

TELEPHONE NOTES.

STAUNTON, VA.—The Staunton Mutual Telephone Co. is being organized.

LOUISIANA, MO.—A telephone exchange has just been established in Louisiana.

OLD TOWN, ME.—It is said that a local telephone system is about to be established in Old Town.

ST. LOUIS, MO.—There is a possibility that the long-distance telephone will soon reach St. Louis.

ATHENS, N. Y.—Efforts are being made to establish a new local telephone line between Athens, Sayre and Waverly.

ELMIRA, N. Y.—The Northern Allegany Telephone Company are making preparations to extend their line as soon as the weather will permit.

NO. TONAWANDA, PA.—North Tonawanda residents who now use the Bell Telephone system are talking of putting in a local service.

JEFFERSON CITY, MO.—The De Soto Telephone Exchange has been incorporated; capital stock, $2,000. Incorporated by J. D. Bath, M. S. Coxwell, Leon Herrick and others.

NATCHEZ, MISS.—Messrs. Will Davis, James H. McClure, J. J. Power and Dr. J. C. French contemplate opening a new telephone exchange in this city.

PETERSBURG, VA.—Sufficient stock has been subscribed to ensure the organization of the proposed telephone company. Address R. D. Gilliam.

ANDERSON, IND.—The city council of Anderson has granted franchises to both the Harrison and American telephone companies.

E. ST. LOUIS, ILL.—The Southwestern Illinois Telephone Company has been formed; capital stock, $100,000; incorporators, Anthony Isch, Daniel Sullivan and W. A. Rodenberg.

QUEENS COUNTY, N. Y.—The Queens County Telephone and Telegraph and Supply Company has been formed to connect the village of Oyster Bay, Queens County, with the village of Huntington, Suffolk County, by way of Cold Spring Harbor from Oyster Bay to Hicksville, by way of Syosset and intermediate points, from Oyster Bay to Flushing by way of Glen Cove, Roslyn and intermediate points; capital, $20,000. Directors: W. L. Swan, G. W. Foller, Samuel Y. Bayles of Oyster Bay, U. S. Croft of Brooklyn, R. Downing, W. F. Johnson, and E. Morgan Griffin of East Norwich.

UNION, S. C.—T. C. Duncan, Geo. H. Oetzel, W. E. Thomason, Wm. A. Nicholson and W. D. Wilbur have incorporated the Union Telephone Co. to construct an exchange; capital $1,000.

GRAND FORKS, N. D.—A telephone company has been organized for the purpose of constructing a line from Fargo to Grand Forks.

LOCKPORT, N. Y.—Lockport has a new telephone company known as the Citizens' Mutual, which will furnish telephones to all subscribers at half the rates charged by the Bell Company.

DULUTH, MINN.—The board of directors of the Duluth Telephone company have elected the following officers: Arthur G. Fuller, president; Col. C. H. Graves, secretary; A. W. Taussig, treasurer; Edward Lomasney, manager.

GLENS FALLS, N. Y.—The Glens Falls, Sandy Hill and Fort Edward Street Railway Company have awarded the contract for erecting a private telephone line along the line of their road to William R. Clothier, of Glens Falls.

CHILLICOTHE, O.—A number of the prominent business men of this city, headed by Judge J. M. Thomas, J. P. Myers of the Electric Railway Company, and others have organized a telephone company, incorporated under the name of the Home Telephone Company. They propose to erect and maintain a city exhange.

PHILADELPHIA, PA.—The Drawbaugh and Central Telephone bills have been passed without a dissenting vote. This action opens up the possibility of cheaper 'phones and is a move toward breaking down the monopoly which the Bell Company has so long enjoyed in the city.

NORFOLK, VA.—The Virginia Telephone Co. has been chartered with a capital stock of $5,000 and privilege of increasing to $100,000, to operate telephone lines in Virginia. D. Lowenberg is president; R. W. Arnold, vice-president, and Chas. Pickett, secretary-treasurer.

ATLANTA, GA.—Messrs. A. J. West, J. R. Collins, T. B. Brady, F. Hardy, N. C. Royster, A. P. Morgan, A. L. Glenn, H. F. West and J. W. McPherson have presented a request for the right to put a telephone system in Atlanta with the same privileges that other companies enjoy. Alderman Harralson presented an ordinance giving them the right to put in the telephone system.

BROOKVILLE, IND.—The Business men's association has held a mass meeting in the city hall, to organize a telephone company. It will be an incorporated stock concern and will reach out to surrounding towns and systems. A memorial was adopted, praying the legislature to adopt a bill compelling telephone companies doing business in Indiana to receive and transmit messages from connecting lines.

LETTERS TO THE EDITOR.

A CURIOUS LIGHT EFFECT.

On 18th street, near the Union Station, this city, there are two different street railway companies using the same track and trolley wire. On a pole, placed near one of the junctions, is a box containing two switches. One of these is a double-throw switch so connected that either company can "pull" this section; the other has then nothing to do, directly, with this combination. To render this arrangement fire proof, the box is lined with asbestos. When one power house shuts this section down, it is my duty to go and climb up the pole and throw the double-throw switch over so that the other company will "pull" until the first one may resume operation, when the switch will be thrown back.

In throwing this switch back it is sometimes necessary to break a pretty heavy current. At night when this is done a very peculiar light effect may be noticed, on the asbestos lining of the box. This light is very white, almost uncanny, and seems to undulate slowly back and forth. This lasts only a few seconds, and is noticeable only after a heavy current is broken at the switch. The warmth of summer and cold of winter do no affect it perceptably. Is this a property of asbestos? If not, what is it?

M. LOGAN.

ST. LOUIS, MO.

[Perhaps some of our readers can solve the mystery.
EDS. E. E.]

SMALL ELECTRIC FOUNTAINS.

THE ELECTRICAL ENGINEER has a foreign inquiry for a small electrical fountain for a garden. It will be glad to receive information, quotations, etc., on the subject as soon as possible.

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CONTENTS.

NIAGARA POWER.

WHEN the projectors of the Niagara Falls power enterprise had raised sufficient capital to guarantee the successful carrying out of their scheme, and when after several years' hard work in investigating the best methods, and in the construction of a plant which easily stands the first of its kind in magnitude in the world, they were ready to deliver power, it might be thought that they had accomplished the most arduous part of their work and that henceforth they would have smooth sailing. But those who have followed the course of events since the Niagara Falls Power Company announced itself ready to undertake contracts for delivering power, will have been strongly impressed with the fact that it is one thing to develop a water power and another thing to induce people to use it. This has been the history of all similar enterprises. In the case of the Niagara undertaking, we must bear in mind that the current has not been turned on, and that manufacturers are naturally slow to move before being in possession of strong evidence guaranteeing the success of such an important step as an entire change of location. On the other hand, new enterprises, especially, will naturally also be slow to assume what they might consider a risk. All these things will, however, disappear in time, and in a very short time at that, we believe. Pending the unquestionable utilization of power directly at the Falls, the city of Buffalo, within 25 miles, presents a field for operation in which all element of uncertainty is removed. That city contains many power users, both large and small, and the promoters of the Niagara enterprise naturally look in that quarter for a disposal of part of their product. But it would seem that after knocking at the city gates for admission, the Niagara Falls Power Co. did not meet with that cordial reception which the benefits it held out would have warranted it in expecting. On the contrary, judging from recent incidents, it seems that obstacles may arise to prevent entirely the consummation of one of the most-to-be-desired objects of the Niagara development.

After a number of sessions of the Board of Aldermen and their committees and sub-committees, and a visit to Niagara Falls, the Niagara Company, upon request, has offered a proposition to the city, in which it states that it cannot accept a time limit for its franchise to distribute current in the city less than the term of its bonds; and, second, that it cannot consent to the fixing of a maximum or other price for power within the city, for the obvious reason that it will be prepared to sell power in Buffalo to those who wish to buy it only because they find it more economical than any other power. It having been suggested that the city of Buffalo purchase the power from the company at Niagara and transmit and distribute it itself, the company offers three propositions: (1.) To deliver 10,000 H. P., undeveloped, on the lands of the company at Niagara, at $10.00 per H. P. per annum, 24 hours per day, the city to make its own wheel pits and side tunnels, and to put in its own wheels. (2.) 10,000 H. P. developed on the shaft of turbines furnished by the company at Niagara, at $13.00 per H. P. per annum, 24 hours per day. (3.) 10,000 H. P. electrical, alternating current, at 2000 volts, 24-hour power, at $18.00 per H. P. per annum, to be delivered within eight months of the execution of the contract. The company states further that it cannot name a price for electric power transmitted to the Buffalo city line, as in the question of transmission are involved the uncertainties of the losses and cost of operation and maintenance.

It seems to us that the main question here at issue is not, "Shall the Niagara Falls Power Company be given a franchise to enter Buffalo," but, "Shall the citizens of Buffalo be given the opportunity and advantage of securing power for less cost than they are now producing it?" We believe that the Niagara Company is entirely consistent in refusing to name a price or to accept a maximum restriction for delivering power in Buffalo, before a single pole has been planted, a foot of wire strung, or a foot of cable laid. That unforeseen difficulties will arise in the transmission of such power for such a distance, we are quite prepared to expect, and while we do not for an instant imagine that they will stand in the way of ultimate success, it is wise and proper to make allowance for them. On the other hand, for the city of Buffalo to embark in such an

undertaking would be assuming a grave municipal responsibility which we believe no city would care to shoulder. To subject the Niagara Company to proper rules and restrictions looking to safety and other necessary attributes of a general system of distribution, is perfectly proper, but to place upon the company a drag anchor in the shape of a maximum charge or rate is quite another matter. Then again, what shall this maximum rate be? The Niagara Company appends to its proposition to the city, quoted above, a few figures of the cost of steam power in Buffalo, in which it states that it is prepared to prove from the test, by a disinterested expert, of the cost of steam power ranging over a period of 18 months in a Buffalo plant using considerable over 1000 H. P. under excellent conditions as to economy, that the annual cost of 11-hour power is $32.70 per H. P. per annum. To these are added other figures, ranging from $45.00 per H. P., for a 24-hour power, to $77.55, at Buffalo. It also quotes the statement by Richard Hammond that for 1000 H. P. 10 hours per day, the cost is $21.00, and the company adds that it is prepared to prove that under the conditions assumed, the annual cost is not less than $32. Dr. C. E. Emery has, indeed, shown in the exhaustive study made by him, not long ago, that with large triple expansion, compound engines, with coal at $3.00 per ton, a horse-power for 10 hours a day costs $25.27. The figure given by Mr. Hammond, if correct, must present a condition of affairs which is little short of ideal, and which cannot be counted on in actual practice. In this connection it may be interesting to recall the celebrated estimate made by Messrs. Houston and Kennelly, which appeared in THE ELECTRICAL ENGINEER of May 2, 1894, according to which the annual cost at 60 per cent. full load of 22,500 K. W. delivered at Buffalo from Niagara, was $13.29 per H. P. If the latter figure be anywhere near correct, we believe that the margin between it and the present actual cost of power by steam in Buffalo is such as to allow of considerable reduction to power users in Buffalo and still leave a handsome profit to the company, which no one ought to begrudge it—least of all those who will benefit by the reduction. A franchise which is practically prohibitory cannot but react to the loss of the citizens of Buffalo, who, if the electric power rates do not meet with favor in their eyes, are always at liberty to maintain and operate their present steam plants.

AMERICAN AND FOREIGN PRACTICE.

America has become quite accustomed to being written up by foreigners whose opinions are based on observation gathered from a car window, and whose criticisms, therefore, we treat lightly, but when an American engineer compares disadvantageously electrical work here with that done abroad, people are bound to treat it seriously. Such in its nature is the most interesting account which Mr. H. Ward Leonard gives in his paper read before the A. I. E. E., of a recent trip abroad, during which the author had opportunities of inspecting a variety of electrical work. Analyzing Mr. Leonard's paper, we conclude that most of his criticisms are based on the alleged fact that the giant electrical monopolies of the country have stood in the way of progress, and more particularly in preventing the trial of devices and systems of which Europe presents varieties unknown among us. There were not wanting, among those who discussed Mr. Leonard's paper, defenders of American work and methods, and who even availed themselves of Mr. Leonard's figures to disapprove his own statements, especially where he refers to the lower cost of electrical apparatus in this country as compared with that abroad. The variety of work, which Mr. Leonard points out as characteristicof foreign electric central stations, is, of course, due to the employment of consulting engineers, in most cases, and while the relative advantage of a third party in such matters may at one time have been a debatable question in this country, we believe that the time has now arrived, as Mr. Leonard intimates, when the consulting engineer is requisite in order to obtain the best results with the variety of electrical apparatus and systems now available and offered by the various companies in the field. We confess our surprise at Mr. Leonard's statement as to the status of the storage battery abroad. Germany is the only place in which the storage battery has been given any extended trial in a large number of stations, and no one who has not studied the question on the ground in that country is, we think, qualified to express an opinion on it. We all know how engineers are prone to coddle their own little pet schemes, but we think the results obtained in Germany must controvert any mere off-hand statements, for such indeed are the basis of Mr. Leonard's remarks on that subject. It is, indeed, curious how great is the diversity of opinion on the subject. When President Insull of the Chicago Edison Co. returned from Europe the other day, his mind was made up against any extension of work in Chicago with the aid of the battery; yet at that very moment, Mr. Edgar of the Boston Edison Co. was placing an order for prompt delivery for the biggest station battery outfit in the world.

EXIT THE BATE CASE.—LAMPS FREE.

In the opinion handed down by the United States Supreme Court on Monday, March 4—which is a final adjudication in the now famous Bate refrigerator case—a conclusive deliverance is made upon the interpretation of that exasperating provision, Section 4887, of the Revised Statutes. This judgment affirms the doctrine of the Circuit Courts that the term of an American patent expires with that of the foreign patent expiring first, irrespective of the relative dates of domestic and foreign application for a patent on the same invention.

The decision seems in no wise to touch the intrinsic merits of Section 4887—a piece of legislation that has justly incurred the disapproval of the best minds among patent lawyers of distinction (such as the late and lamented Grosvenor P. Lowrey) because of its obvious inequity. But Section 4887 has now for a long period been uniformly interpreted by the Circuit Courts according to its obvious verbal significance, and vested interests with invested capital have long gone upon the assumption that the law was settled, and that they were secure in their reliance upon the general understanding of its scope and purpose. Now the Supreme Court confirms established rulings of the circuits and whatever may be thought amiss is left for legislation by Congress. Such legislation, happily, cannot be *ex post facto* nor invalidate the judgment of our highest tribunal.

While no judicious observer of the history of incandescent electric lighting will be disposed to minimize the honor due to Mr. Edison for his achievements, we feel well assured that both electrical experts and the general public will approve the final dissolution of the monopoly sought to be founded upon this questionable patent; while they will at the same time be likely to agree, for the most part, that section 4887 is an absurd provision and that an American inventor who has applied for a domestic patent before he has applied for a foreign patent is merely unfortunate and not derelict if the foreign patent issues first.

From the point of view of electrical industry in general it is gratifying that the manufacture of incandescent lamps will be henceforth free, and that those firms and companies which, relying upon the long delay of the owners of the Edison patent in seeking to enforce their claims, as well as upon their confessed uncertainty as to the life of their patent, have gone into the business in good faith and have made good lamps, can now expand their work, assure adequate competition, and secure to themselves some reward for their efforts.

ELECTRIC TRANSPORTATION DEPARTMENT.

NEW YORK RAPID TRANSIT ROUTES.

The New York Rapid Transit Commission at a special meeting held Feb. 16 unanimously adopted the new routes as follows:

A route, the centre line commencing at a point under tht westerly side of Whitehall Street, distant along the same 62.5 feet north from the northerly line of South Street produced; thence by diverging lines under Whitehall Street and Battery Park and State Street, forming a loop line, the tracks converging to parallelism at a point at or near the westerly side of State Street and the southerly side of Battery Place; thence under Broadway and Union Square to Fifty-ninth Street; thence under the Boulevard to a point at or near Ninety-third Street; thence by viaduct along the Boulevard to a point at or near One Hundred and Eleventh Street; thence under the Boulevard to a point at or near One Hundred and Twenty-third Street; thence by viaduct along the Boulevard to a point at or near One Hundred and Fifty-first Street; thence under the Boulevard to a point at or near One Hundred and Fifty-sixth Street; thence by viaduct along the Boulevard to a point at or near One Hundred and Fifty-ninth Street; thence under the Boulevard to One Hundred and Sixty-ninth Street; thenc under Eleventh Avenue to a point at or near One Hundred and Eeghty-fifth Street.

Alio, a loop from Broadway, under Mail Street, City Hall Park,sPark Row, and Chambers Street, and again connecting with the B roadway line.

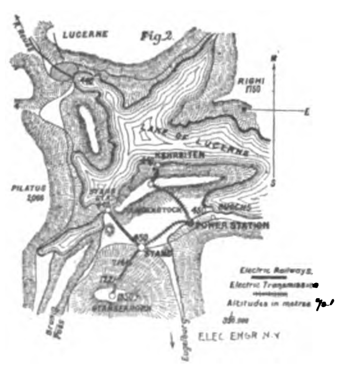
Also, a route, the centre line of which shall diverge from the Broadway line at or near Fourteenth Street and run under Union Square to Fourth Avenue; thence under Fourth and Park Avenues to a point at or near Ninety-eighth Street; thence by a viaduct along Park or Fourth Avenne to the Harlem River; thence turning to t he right by bridge across the Harlem River, and thence to the left until it shall coincide with the centre line of Walton Avenue pro duced at or near its intersection with One Hundred and Th rty-eighth Street; and thence along the line of Walton Avenue to a point at or near One Hundred and Forty-sixth Street.

All parts of the routes formerly agreed to which are not coincident with these were formally abandoned. The sense of the meeting was also expressed as being in favor of east and west side extensions to the city line, to be built, in addition to the other lines, as soon as possible.

THE BURGENSTOCK ELECTRIC CABLE RAILWAY.

An interesting description of the unique electric cable railway Kehrsiten, Switzerland, up the steep mountain ridge called the Burgenstock appeared recently in the London *Engineering*, from which we reproduce the accompanying illustrations.

It has been customary in several cable railways operated on steep inclines for the descending car to use a counter-weight or ballast of water in order to overcome the weight of the ascending car and haul it up the grade. This method of operation has advantages where water costs nothing, but it adds tremendously to the dead weight carried by the trucks and necessitates much heavier and more expensive construction of track, cable and



Figs. 1 and 2.—General View and Plan, Burgenstock Railway.

mechanism. These disadvantages are obviated on the Burgenstock road by the adoption of electric motive power.

Figs. 1 and 2 show the general view and the plan of the road. Its actual length is .6 mile. Its initial gradient at the base is 32 per cent. changing midway to 58 per cent. and continuing thus to the top. The declivity of the slope is 45 degrees, which accounts for the curves in the road.

The motor station is placed at the summit of the line, and comprises, besides two direct-current motors of 25 horse-power each, a 15-kilowatt dynamo, also direct current, for lighting the Burgenstock station, buffet, and hotels. Current is derived from a water power station near Buochs, Fig. 3, distant about 2.5 miles and situated in the valley beyond the Burgenstock ridge, 1,400 ft, lower than the motor station. In connection with the motor station there is also a pumping station with a 15-horse-power motor for the water supply of the hotels. Both this and the dynamo for lighting are driven when the cable railway is not running. With a view to save copper, and at the same time to work the different machines independently of each other, a high tension transmission of 1,600 volts, on the three-wire system, 4.5 millimetres in diameter, was adopted, so that when only one machine is running, the neutral and one outside conductor are put in parallel. The transmission is much exposed to atmospheric discharges, and the generating as well as the motor station are therefore provided with Thury lightning arresters (toothed dischargers with impedance coil and condenser) and automatic cut-outs. Both the enerators and motors are of the six-pole Thury type supplied bgy the Geneva Electrical Company. The output of the two series-coupled generators is, at 800 revolutions, 25 amperes at 2×800 volts, or 60 horse-power for both, while the two motors in series give, at 700 revolutions and 2×700 volts, 44 horse-power, or 73 per cent. of the generating power. The work to be performed by the electric motor is equal to the difference between the component of gravity of the descending car and the tractive force required to haul the ascending car and the cable up the incline.

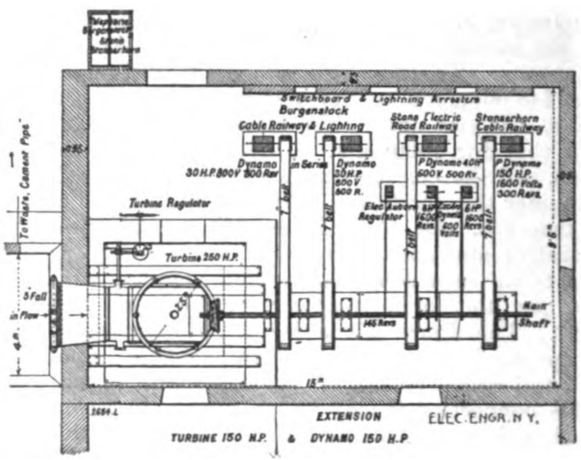


Fig .3—The Burgenstock Railway Power Station.

The two 30-horse-power generators give, on the motors, 44 horse-power, the latter give, on the line, 37 horse-power; the total efficiency is, therefore, $0.73 \times 0.83 = 60.6$ per cent.

HOW SHALL THE TROLLEY BE APPLIED ON STEAM ROADS?

I should consider the trolley with overhead construction as now in general use in cities, but with improvements in the mode of stringing wires and line insulation so that the voltage can be raised, the method to adopt in changing steam roads to electricity. I would use self-propelled cars for local business and the electric locomotive with train at high rate of speed for through business or freight.

As the direct current is in general use, and in passing through cities other electric roads would have to be crossed, to prevent complications I should think it advisable to use the direct current, but increase the voltage as high as the insulation of both generators and line would allow; at points of crossing other roads the potential could be regulated. Increase of voltage is essential for the economical distribution of the current and the number of power houses. The whole problem is simply this; How high can the potential be raised and distributed with any of the systems, so as to reduce the first cost of construction on long distances, so as to compete with steam?

It must be admitted that the problem is to-day unsolved, and the long distance road needs some fearless genius to do for it what Frank J. Sprague, seven years ago, did for the short—try it practically.

A. Langstaff Johnston.

Philadelphia, Pa.

ELECTRIC CARRIAGE DRIVEN BY TOMMASI ACCUMULATORS.

An electric carriage has recently been put in operation on the streets of Paris, operated by storage batteries. The latter are placed in a box situated behind the seat of the cabriolet. It is also provided with a regulating switch and a powerful foot brake, which acts also as a circuit-breaker when the brake is applied.

The accumulators employed are of the type designed by Dr. D. Tommasi. Each electrode consists of an envelope of celluloid, perforated by a large number of small holes and filled with active matter, in the centre of which is placed a rod of lead, the only function of which is to act as a conductor for the current, and not as a support for the active material, as in the usual type of accumulators. By this construction, the disintegration of the electrodes and the falling out of the active matter is prevented. The capacity of these accumulators is about 25 ampere-hours per kilogram of electrode. They are able to resist completely the shocks encountered, and stand exceedingly well the very high discharges to which they are subjected.

The battery consists of 21 elements, each weighing 13.3 kilograms, enclosed in seven boxes of three cells each. The cells are connected in series and can deliver 100 amperes at 40 volts. At starting and on heavy grades the current rises to 200 amperes. Under average conditions the battery has sufficient capacity to operate one and a half hours, which corresponds to a capacity of 7.4 ampere hours per kilogram at low discharge; 11 ampere hours per kilogram at average discharge, and 15 ampere hours per kilogram at maximum discharge. Under more regular conditions the capacity is 22 ampere hours when discharging at the rate of 1 ampere per kilogram; 18 at 3 amperes, and 15 at 6 amperes. The total weight of the carriage with two passengers is about 1200 kilograms, and the speed 12 miles an hour. The carriage starts very easily and can be stopped as suddenly as desired.

NEW ELECTRIC RAILWAY WORK IN CHICAGO.

THE ordinances for the West and North Chicago Street Railroad Companies, passed by the city council on January 28, were both vetoed by Mayor Hopkins on Feb. 4, and substitutes submitted containing several amendments, the chief one being a compensation clause, whereby the street railway companies agree to pay $5,000 each a year into the city treasury as compensation. Contrary to the mayor's expectations, the new ordinances were promptly passed by the council.' If the West Side Company accepts the ordinances, which seems highly probable, it will pay into the city treasury for franchises secured this year $618,000 within the next twenty years.

The probabilities are that before very long the downtown district of Chicago will have its electric lines and that they will be operated by the overhead trolley system. At a recent meeting the City Council passed two blanket ordinances, one of which authorizes the North Chicago Street R. R. Co. to connect the tracks on Indiana Street and on Grand Avenue with the tracks of any railroad owned, leased or operated by it or by any other company. The road is to be completed one year from April next and to be operated by electric power or by any power the company may be at present authorized to use. The ordinance also authorizes the company to operate its electric cars over its cable tracks when necessary to connect with another electric line.

The second ordinance provides for the laying of tracks in a large number of streets. The first section contains permission to use overhead electric wires in State street, between Lake and Randolph, and to operate its cars in State street, between these points, by electric power. This is the opening wedge for trolley wires in the down town district. The streets covered by this ordinance are as follows: West Harrison street, between Western avenue and Kedzie avenue; Twenty-sixth street, between Blue Island avenue and Crawford avenue; Wood street and North Wood street, from Blue Island avenue to Milwaukee avenue; North Lincoln street to Webster avenue; Laurel street, between Thirty-ninth and Thirty-first streets; Thirty-first street to Main, thence on Main to Throop street, between West Twenty-first street and West Taylor street; Sangamon street, between Austin avenue and Erie street, thence on West Erie street to the north branch of the Chicago River; West Twenty-first street, between Western avenue and Douglas boulevard, and West Twenty-first street, between Center avenue and Canalport avenue.

The General Electric Company, at the same meeting presented an ordinance, which was referred, and which contains features that are novel and somewhat out of the usual run of ordinances of that kind passed in Chicago. The ordinance provides for the construction, maintenance and operation for thirty years of a single or double track on the following streets and avenues:

From Fourteenth and Dearborn streets, on Fourteenth street to Plymouth place, north to Jackson, west to Sherman, north to La-Salle from connection on Jackson to Monroe, west to Market, south to Jackson, east to Sherman, south to Polk, east to Custom House place, south to Fourteenth, and thence east to connection with itself and following lines: Commencing at connection of lines mentioned in the foregoing, south on Dearborn to Twenty-third, east to Wabash avenue, south to Fifty-ninth, west to Wright, and south to Sixty-ninth.

Commencing at Wabash avenue and Thirty-seventh street, east on Thirty-seventh to Vincennes avenue, on Vincennes avenue to eastern section of Thirty-seventh street, thence easterly around Ellis Park to Ellis avenue, south to Forty-fifth street, to Woodlawn avenue, to Sixty-fourth street, east to Madison avenue, thence via a single track south on Madison avenue, east on Sixty-fifth, north on Grace avenue and west on Sixty-fourth to Madison avenue, forming a loop.

Commencing at the intersection of Ellis avenue and Forty-fifth, thence west on Forty-fifth to Halsted street, with permission to cross Wentworth avenue on an angle, or otherwise in order to meet the two sections at Forty-fifth street, where they offset.

Commencing at the intersection of Fifty-third street and Woodlawn avenue, east on Fifty-third to Madison avenue, south to Fifty-eighth, and thence to Woodlawn avenue.

The company is authorized by the ordinance to operate by the underground electric system and to connect its electric conductors by substantial underground devices with a power station. The use of other described power may be permitted by action of the council. The cars are to be of the latest design, kept in first-class repair, lighted and heated from October to May. The company agrees to keep all the streets covered by its ordinances paved from curb to curb and in first-class repair. The lines asked for are to be built within two years, with the usual allowance of time. For crossing railroad tracks it is provided that subways may be built.

Rates of fare shall be 5 cents either way on any of the specified lines. Six tickets shall be sold for 25 cents. The company agrees to light all the streets over which its lines pass with electric arc lights, sixteen to the mile, and carry free all police, firemen and letter carriers when in uniform. A bond of $25,000 is provided for, and the city is held free from all damage.

THE TRANSFER SYSTEM IN BALTIMORE.

In Baltimore free transfers are now issued at some 40 different points; in some cases it is possible to ride 20 miles for a single fare. As a rule, in any city transfers are confined to different lines of one company; but at a crossing of the Lake Roland Elevated and Central roads free transfers are given from one to the other. A station is located at the junction and an agent provides the transferring passengers with a ticket. At the end of each quarter officials of the two companies meet, exchange coupons and divide equally the residue of fares collected by one company over the other. This arrangement has resulted in greatly increasing the traffic of both roads.

TROLLEY COMPETITION IN PENNSYLVANIA.

Electric trolley road competition has already compelled the Philadelphia & Reading R. R. Co. to make a concession in the price of its monthly tickets between Philadelphia and Wayne Junction. The operation of trolley lines in Germantown and Chestnut Hill has also reduced the receipts of the Pennsylvania lines, so much that a number of the trains have been withdrawn. The trolley lines to Media, Darby, Chester and other points on the Philadelphia, Wilmington & Baltimore Division are also making their influence felt, and the officers of the Pennsylvania R. R. are now proposing to meet this competition, either by reducing fares or by reducing the train service.

THE NEW YORK-PHILADELPHIA ELECTRIC ROAD BEGUN.

Work has been started at Somerville, N. J., on what will be, when completed, the longest trolley road in the world. The contractors are under bonds to complete by April 10 the first five miles of the New York and Philadelphia Traction Company's proposed electric railway between the two cities. The first rail will be laid at Raritan. It is proposed to construct a mile of track each week, and connect the towns of Somerville and Bound Brook with the city of New Brunswick. The road will run through an agricultural district, and the traction company is having built a number of combination cars to carry the products of the farms to the market.

HARTFORD, CONN. The new power house for the Hartford Street Railway Co. is now completed and is said to be one of the finest, if not the finest, in the New England states. It is 66 ft. wide and 230 ft. long, entirely fire-proof, no wood work at all having been used about the building. It was designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn., and is covered with their patent anti-condensation corrugated iron-roofing.

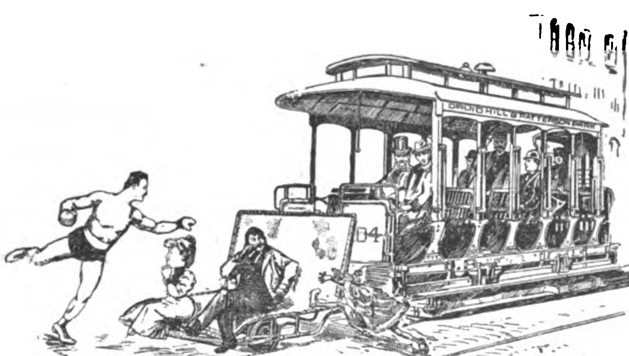
THE EVOLUTION OF THE FENDER.

Acting on the principle that it is well to provide fenders for electric and cable cars, a youthful genius of Baltimore has gone one step further. He has built a fender to which a car may be attached if the amount of traffic should justify such a step.

This fender we venture to illustrate as it appears on the street railways of Baltimore. The inventor is young—"some" seventeen years of age, we are informed by the *Manufacturer's Record*—and his name it is Herbert Bryan Ewbank, Jr. Were he older his fender might perhaps be larger, but it is sweet to be young. A detailed description of this boon to a trolley ridden public is rendered unnecessary by the accuracy of the engraving. The point to which we would call especial attention, however, is the luxury of the device. It will be noticed that those passengers fortunate enough to have seats on the fender wear happy smiles, while the general public utterly ignores the car in its haste to secure the remaining preferred space. A city ordinance prohibits the wearing of hats on the fender. These are usually handed to the conductor on taking one's seat, though the fender habit has taken such hold upon the citizens that many have ceased wearing hats at all, rather than run the risk of losing the chance of a seat. It will be noticed that the two gentlemen just entering the fender are hatless.

No expense has been spared to make the fender thoroughly comfortable and beautiful. It is provided with C springs, pneumatic cushions, electric lights, (not shown in the illustration), stock ticker, typewriter (who will be seen on the extreme end) and all the comforts of a well appointed home. The seats are upholstered in pre-Raphaelite hues and are so seductive that the passengers have to be forcibly removed at the ends of the route.

The Ewbank Car-Fender Company of Baltimore City has been incorporated, with $150,000 capital to manufacture and introduce



THE FENDER UP TO DATE.

the device. The incorporators are Dr. Herbert B. Ewbank, Messrs. Daniel E. Conklin, William J. Sneeringer, O. G. H. E. Kehrhahn and Frank M. Baker, who are also directors. The officers of the company are Dr. H. B. Ewbank, president; Messrs. Daniel E. Conklin, vice-president; William J. Sneeringer, treasurer; O. G. H. E. Kehrhahn, secretary; H. B. Ewbank, Jr., superintendent of construction.

THE ELECTRICAL BRANCH LINES OF THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

In answer to an inquiry addressed to Mr. C. P. Clark, President of the N. Y., N. H. & H. R.R. Co., we have been favored with the following interesting letter from that gentleman:

Replying to your inquiry, let me say that the interest which the public press has taken in a very simple experiment is entirely disproportionate to the importance of the thing now proposed.

The Nantasket Beach Railroad is a short branch line, nearly seven miles in length, perfectly level, and reasonably straight, mainly used for the summer business, which varies with the weather and with the season. The problem is somewhat complicated by the fact that from one end are received large excursion trains almost daily in July and August, and from the other end large crowds who come down from Boston by boats and land at Pemberton. The business derived from these two terminals of the branch line is supplemented by a considerable amount of short riding, for the sake of riding along the beach. Occasionally an additional draft is made upon the railroad by reason of fog when the boats are unable to run to the City, and five or ten thousand people must be carried by rail to Boston on short notice.

The situation is exceptionally favorable as a place for experimenting as to the use of electricity as a motive power, and the Company is engaged in fitting up this seven miles for electrical use. We have contracted for two Green engines, each 820 nominal horse power, and for eight horizontal tubular boilers with return flue; two direct coupled generators 500 kilowatts each made by the General Electric Company. We propose to use a No. 0000 copper trolley wire with naked feed wires carried upon iron arms bolted to Southern pine poles, 30 ft. in length, 12 × 14 inches at the butt and 10 × 12 inches at the top. These poles are to be located between the tracks which are being laid to 13 feet centres.

The equipment is to be made interchangeable with our standard cars and at first will consist of six motor cars, each with two motors of 100 H. P. nominal capacity each. These are expected to draw with ease a trailer car. Both these motor and trailer cars are 50 ft. in length, open cars, lighted with electricity and entered from the side. In addition to this, we are preparing four baggage cars, 30 ft. in length, of which two are to be fitted with two motors and two with four motors, all of the General Electric Company's construction. By loading these baggage cars and so increasing their tractive force, we expect to determine the efficiency of special motors.

This is the extent to which this company is now expecting to go. But from experience derived during this summer (for the road is contracted to be in working order some time in the month of May) we shall be able to determine upon what other branches or parts of our system transference of steam power by the electric current may prove efficient and economical. In discussing the subject with various electrical engineers and companies we find that we are working in a somewhat unknown field and must proceed cautiously, although the physical condition and grades of the road itself, the nature and volume of the travel, and its use in summer time only, make it less of an experiment than to equip graded, hilly, all-the-year round roads on which the traffic is limited.

In connection with the above it is very interesting to note the subjoined statement from the *Day*, of New London, Conn.:—"The directors of the New York, New Haven & Hartford road are considering the advisability of establishing electric power plants at the terminus of all the small branches which radiate from the trunk lines. The principal lines are those between Berlin and New Britain and Middletown on the Hartford division; between Stamford and New Canaan on the New York division, and between Watertown and Waterbury on the Naugatuck division. There are many other minor branches in the system connecting with one or more stage lines leading to towns in the interior.

"Extension of the branches would drive the stages out of business. If the scheme is carried out small feeder lines will be built wherever the distribution of population warrants, all of which will be preliminary to the equipment of the main lines. It is said that the company also intend to keep a weather eye on the street railway lines in the various cities in its territory and wherever they can be obtained at a reasonable price the money for their purchase will be forthcoming.

"Railroad men think that the project will be of immense proportions. The creation of the office of electrical supervisor and the selection of a man with the electrical experience of Colonel N. H. Heft of Bridgeport, is considered to be the beginning of operations that will not cease until all the company's cars will be propelled by electricity. It is asserted that the company is naturally compelled to take some such steps as this in connection with electric roads, or lose its short passenger traffic entirely. The only protection is for the company to own electric roads with the rest."

THE TROLLEY ROAD ON GETTYSBURG BATTLEFIELD.

The Gettysburg Electric Railway Syndicate has made a proposition to the United States Commission tending toward amicable adjustment of the differences existing between them. It is practically an acceptance of the Government's terms. The company offers to abandon the road through the Valley of Death and around the Devil's Den region and that portion in front of the Second Corp's line on Cemetery Ridge, on condition that the Government furnishes a route over the Wheatfield Road, and also a route along the crest of Cemetery Ridge east of Hancock avenue, from Seigler's Grove to the tracks of the Reading Railroad branch.

THE AMADOR ELECTRIC FREIGHT RAILWAY IN CALIFORNIA.

MR. LEWIS E. WALKINS, of Worcester, Mass., has received the contract to build the Amador Railroad near San Francisco, and will equip it electrically using Mather dynamos and Card motors. The road is 12 miles long and is designed to carry freight to and from the gold mines; it will be a branch of the Southern Pacific beginning at Carbon City, and is said to be the first electric road in the United States built exclusively for freight traffic. The Walkins type of electric locomotive will be employed on this road.

WILLETS POINT, N. Y.—Col. W. R. King, U. S. N. C., proposes putting in a small electric light plant.

THE MONOCYCLIC SYSTEM.[1]

BY DR. LOUIS BELL.

IT is the purpose of this paper to call your attention to the various methods of central station distribution, involving motor service on the alternating current system, and more especially to a modified single-phase alternating system which lends itself very readily to a very simple and straightforward distribution of lighting without sacrificing the excellent motor service which makes the true polyphase systems so desirable. For all around central station work, the lighting service is of most fundamental importance, and convenience and economy in this particular must, in a vast majority of cases, be the first consideration. The author then referred to the systems of distribution illustrated in the diagram, Fig. 1, showing the amount of copper required in each as indicated at the side in each case; and the various disadvantages entailed in operating under them, both as to complexity and difficulty of maintaining balance on the circuits.

It was, he said, for the purpose of preserving that simplicity of distribution which is peculiarly valuable in connection with large central stations, especially those already installed, and joining to this the same ability of running motors found on the polyphase system, that the monocyclic system has been perfected. It is shown in its two-wire form, in Fig. 2. Here, so far as the lighting distribution is concerned, it is absolutely identical with any of the alternating systems now installed, in simplicity, convenience and in the amount of copper necessary. The main circuit of the monocyclic machine constitutes a simple single phase alternator and so far as the lighting on the system is concerned is identical with it, connected in precisely the same way, feeding, if desirable, into the same circuits without change. There is, however, on the armature of the monocyclic machine a supplemental coil, shown on the diagram as connected to the middle point of the main winding on the monocyclic machine, from which a power wire may be led. This need be of but small cross section, and only has to be carried to those points in the system at which it is desired to operate motors, and, as I shall presently show, this power wire enables one to run motors possessing the same desirable characteristics as the polyphase motors, and, indeed, generally identical with them, without in any way disturbing the lighting distribution, except in so far as Ohm's law is a necessary limitation on all combined power and lighting circuits.

In the last diagram here we see the same device applied to an Edison three wire system for the distribution of lights, along with which is carried the same insignificant power wire which permits the successful operation of motors. The value of the three wire feature in the distribution of lights is evident, the amount of copper being the same as in an Edison system of the same voltage. With this monocyclic system, we can compound the generators for any reasonable loss in the line, and can arrange the lighting system without incurring any troublesome questions of balance, so as to give as good regulation even as can be obtained on a direct current system. Beyond this, we have the power of running motors.

It is instructive to glance over this list of alternating lighting systems to see their relative complexity and advantage. It is especially noteworthy that any and every method of distribution that saves copper introduces in some form or other the question of balance. This is the price we pay for reduction in cost of conductors. It has not seriously interfered with the use of the Edison three wire system; in fact, those most familiar with that system were the first to make light of the difficulty; nor do I think it stands as a valid objection to the use of the polyphase systems in cases where they are desirable, as none of them are more sensitive in the matter of balance than the Edison three wire system which is now in such extensive and uniformly successful use. We may further note that in each of the alternating systems where a very great saving of copper is accomplished, a fourth wire is necessary, at least if both lights and motors are to be operated; in each case, however, of trifling size.

Having now looked over the field in general, we may pass to the more minute consideration of the somewhat striking electrical peculiarities of the monocyclic system; peculiarities which although they do not involve any particular complexity, are yet of decided interest.

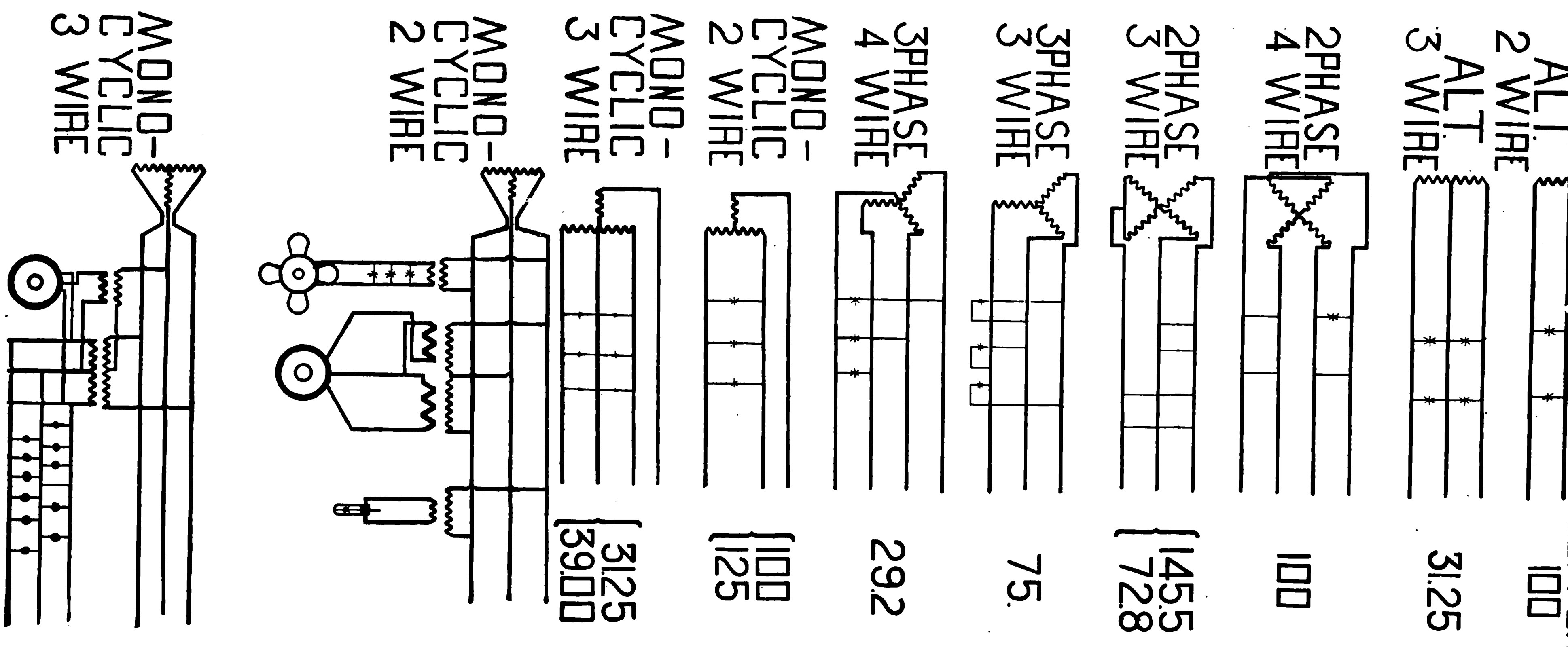
The general principle of the system is well shown in the diagram. So far as the main work of the generator is concerned, its winding is closely similar to that of any well designed alternator. The armature is of the iron-clad type and the winding is made in machine-wound coils which are invariably insulated, and can be very readily slipped into place. There is, however, upon the armature a second set of coils of cross section equivalent to that of the main coils, but composed of comparatively few turns, so that the room taken up on the armature is very small and owing to the shallowness of the slots necessary to accommodate this second or teaser coil, the output of the machine, considered as a single phase generator, is not affected. This teaser coil is located with reference to the main coil as shown in the diagram. Its place on the armature is midway between the other coils and the electromotive force generated is in a direction at right angles to that of the principal coil. It is evident, now, that if we connect the terminal of this teaser coil with either of the terminals of the main coil, we shall get an electromotive force compounded of the two, and in some intermediate direction. In general, by varying the proportions of the two coils, and hence their electromotive forces, we could obtain a resultant electromotive force between their terminals having any angle we pleased with either the main or the teaser coil. If, then, wires are taken upon the line from the terminals of the main coil and also from the teaser coil, we can obtain from the main line three electromotive forces, two of which are symmetrically situated with reference to the E. M. F. of the teaser coil, and bear to it any phase relation that we please.

One of the most convenient arrangements, and that which is most generally adopted, involves such a relation of the electromotive force of the teaser coil to that of the main coils, that we shall have on the line three electromotive forces approximately 60 degrees apart. In other words, the resultant E. M. F.'s between teasers and main coils are each 60 degrees from the E. M. F. of the teaser coil. Such an arrangement is that shown in the diagram. Under these circumstances, it is clear that if one of these electromotive forces were reversed, either in transformers or anywhere in the translating devices, the result would be E. M. F.'s 120 degrees apart, one of them having been turned through an angle of 180 degrees. Meanwhile, the relation between the power wire, which is connected to the teaser coil, and the outside wire has no effect upon the electromotive force between these outside wires, since the electromotive force of the main coil itself does not interact with the power wire, except in so far as a portion of it may act with the power wire to form a resultant phase, and electromotive force for running motors. Consequently, so far as lights are concerned, the two outside wires behave precisely like the leads from any other alternating generator, while so far as motors are concerned, we have the power of getting our three electromotive forces 120 degrees apart, and hence have the same magnetic effect as with a three phase system.

The arrangement of lights and motors with this device is clearly shown in the diagram. It is evident that we can take from the outside wires of the monocyclic system either arc or incandescent lights anywhere and to any extent the capacity of the machine permits, working for the incandescents either two or three wire distribution at option. For a motor, two transformers are connected anywhere we please, one between the power wire and each of the outside wires. At this point the resultant phases come into play and the necessary reversal of one of the electromotive forces is accomplished by the very simple and obvious device of reversing one of the secondaries, as shown in the diagram. To the secondary circuit thus constituted, we can connect a standard induction motor which will start and run as well as if connected to a regular three phase system, or instead of reversing one of the transformer secondaries we may accomplish the same virtual reversal of the electromotive force by reversing one of the coils in the motor itself. We therefore have a system which, so far as lights are concerned, is a simple alternating system; so far as motors are concerned, the dynamical equivalent of a polyphase system. With a differently proportioned transformation we could place upon the secondaries two electromotive forces 90 degrees apart if necessary, and then run two-phase motors instead of three-phase motors if there were any object in so doing. Such an arrangement, however, would be less desirable than that of the quasi three phase system, for the reason that without gaining anything in the motors we should have to generate a larger electromotive force in the teaser coil, and hence take up more room on the armature with it; perhaps enough to have an effect upon the output of the machine considered as a single phase generator.

It is sufficiently evident that the method shown would not be the only way of getting the same result. For example, in this second diagram a somewhat different arrangement is shown accomplishing precisely the same end. Here our object is to operate secondary mains on the Edison three wire system and in connection with them to run motors at any point we please. A large transformer to which the secondary is connected on the three wire system is therefore installed, and the secondary mains distributed in any manner we please. A second and small transformer, proportioned to the total amount of motor service desired, is connected as shown in the diagram, and the power wire leading from it is taken through the whole or part of the three wire system. The device is analogous to the arrangement of the generating coils themselves, and the result is the ability to operate a standard induction motor by connecting it anywhere on the three wire system to the two inside wires and to the power wire. Such an arrangement as this is immensely convenient in distributing power and light in cities where, for example, it is desired to establish an extensive system of secondary mains through Edison tubes or other convenient underground distribution. It is, furthermore, interesting to know that one is not confined to the use of either two or three phase induction motors, since a monocyclic generator connected to the primary circuit

1. Abstract of a paper read before the N. E. L. A., at Cleveland, O., Feb. 19-21.



FIGS. 1 AND 2.—DIAGRAMS SHOWING VARIOUS SYSTEMS OF CURRENT DISTRIBUTION.

makes an excellent synchronous speed motor without the assistance of a starting motor, in this particular being vastly superior to the pure single phase synchronous machine.

But, it may be asked, how about this power wire? In case, for example, of a transmission over a considerable distance before the distributing point is reached; must the power wire be part of the transmission system? In answer, I need only call your attention to the fact that the essential point of the monocyclic system, so far as motors are concerned, is the establishing of an electromotive force bearing the same relation to the system as is borne by the teaser coil of the generator. Consequently, in case of a transmission plant, the main generators at the distant station may be simple single phase machines, the subsidiary electromotive force being furnished by a synchronous motor or similar device at any point in the system. So we might readily have an extensive transmission with a monocyclic machine in the sub-station of such size as is necessary to furnish current for what motors may be upon the system. The power wire would then run only to the sub-station. Another interesting peculiarity of the monocyclic system, and one which is not without importance in case of an extensive power distribution, is the following:—

Under ordinary circumstances, induction and synchronous motors are wound so that the counter E. M. F. affects the system in a perfectly symmetrical manner, and the current flows over all the wires with some degree of symmetry in response to the demands of the motors on the system. It is customary, however, in the monocyclic system to employ motors so wound as to throw a high counter electromotive force into the power wire when the motor is at speed and loaded, thereby reducing the normal current carried over the power wire to a purely nominal amount, and this can evidently be done without sacrificing much in the matter of starting, since at the start all the counter electromotive forces in the motors are zero. We have, then, a motor system of a type really peculiar to the monocyclic system, in that each motor will start under the same conditions of impressed electromotive force as if it were a polyphase motor; while, when at speed and loaded, it would be operating virtually as a single phase machine. If, however, it were overloaded so that it would tend to slow down or stop, sufficient energy would flow over the power wire to bring it back to speed, just as if it were a polyphase machine. This is only one of various interesting ramifications in the system when developed to meet special conditions. The connections, shown in the diagrams, however, are those of the most direct applicability and probably which would be most extensively used for central station service.

At this point it may be appropriate to ask what is the disadvantage of such a system. It evidently secures exceedingly marked advantages in the ability to operate the lights on existing circuits or with the simplest possible kind of distribution, and at the same time to run at any point in the system synchronous or induction motors of well tried and familiar types. The question can be readily answered; in fact, the answer is almost obvious.

The price which we have to pay for this advantage is the installation of the power wire which necessarily adds something to the weight of copper in the system and to the trouble of installation. Under all ordinary circumstances the power wire need be of trivial cross-section compared to that of the other wires, since, as a rule, the energy required for operating the motors from the given central station is small compared with the total capacity of the station; and further, it is worth remarking that the monocyclic motors, either synchronous or induction, will run perfectly well if the power wire is disconnected after the motor is at speed, operating them as single phase machines.

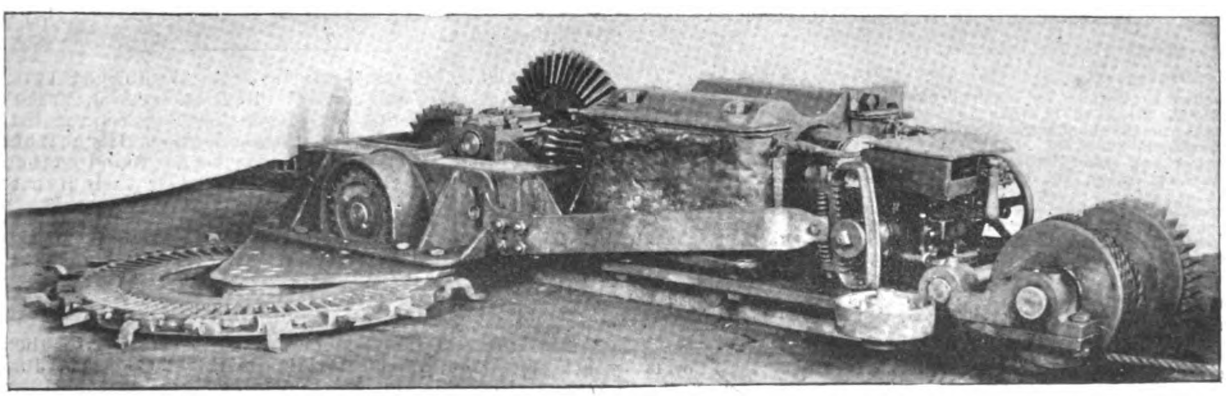
It is, of course, well known that the single phase synchronous motor gives admirable results, and it is also true that a single phase induction motor can be constructed of excellent efficiency and other electrical properties. The only material difficulty in this case is to get the motor to start with a good torque. The monocyclic connection enables this to be accomplished. After the motor is at speed the power wire becomes no longer necessary to successful operation, so that in spite of the necessary existence of the power wire it is easy to see that the additional amount of copper is not likely to be burdensome in central station operation. It would hardly ever be necessary to install a power wire of more than one-fourth the joint cross section of the others, as given in the diagram, and generally a much smaller wire will suffice.

As to what has already been done in the installation of such apparatus, a considerable number of these monocyclic generators are in daily use in central stations, for the most part operating over circuits already established and displacing the higher frequency alternators which had been previously used. They are giving excellent results, and the operation of the motors, wherever employed, has been highly satisfactory.

THE CARR "LONGWALL" ELECTRIC MINING MACHINE.

The accompanying engraving represents the new "longwall" mining machine designed by Mr. W. J. E. Carr, M. E., of the Leavenworth, (Kan.) Coal Co. two of which have for some time been at work successfully in mines of that company.

The machine consists of a 30 H. P. motor wound for 800 volts, and run at 1,000 revolutions per minute which drives a train of gears in an oil tight casing and keeps all dust from the gears. The cutter wheel makes 34 revolutions per minute and has 19 picks or cutters which cut a channel under the coal. The cutter wheel is so arranged as to be tilted in any position to suit the vein of coal.



THE CARR "LONGWALL" ELECTRIC MINING MACHINE.

The machine runs upon a rail in the centre of the machine frame and is propelled by a wire rope wound upon a drum in front of the motor. The drum is operated by a ratchet movement and can feed from 6 to 24 inches per minute. The machine rails are held in place by screw jacks, and the end of the rope is fastened to a jack to pull from.

The cutting rate of the machine is 120 lineal feet per hour. But time is taken up in moving rails and setting jacks; but 450 lineal feet per day 30 inches under have been cut, including all these stops in a vein of coal 20 inches thick and where the total height is only 24 inches and the width 3 feet. The weight of the machine is 2,700 lbs. length, 7 feet; width, 32 inches; height, 18 inches; and it requires 4 men to operate it.

In a thicker vein of coal much more cutting could be done as there would be room to move the rails without stopping the machine and from 600 to 800 lineal feet per day 30 to 36 inches under could easily be cut. It requires about 16 H. P. to cut 5 square feet per minute. The motor was built by the Sperry Mining Machine Co. and the coal cutter at the Leavenworth Coal Co.'s Shops.

Mr. Carr has designed this machine as the result of practical experience in the mine and has found that a cutter wheel does more and better work than a chain can do, as proved in the work of the Leavenworth Coal Co. The clay under the coal there is very hard and has a good deal of limestone mixed with it which used to break chains every day but since using the cutter wheel that trouble has ended. The wheel costs less and wears longer than a chain as the chain machine is working alongside of the cutter wheel machine and the wheel shows very little wear while the chain machine has worn out 8 chains, both machines running the same time. The machine illustrated has only been built for a trial and the construction will be changed and new devices put on before it is put on the market.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the regular monthly meeting of the Council held Feb. 27th it was voted that the General Meeting of the Institute be held at Niagara Falls beginning on June 18th. It is proposed to devote this meeting principally to the question of Power Transmission.

The following Associate Members were elected:—Franklin Robert Anson, manager, Salem Consolidated Street Railway Co., Salem, Ore. Arthur B. Cumner, senior member, firm of Cumner, Craig & Co., 69 Broad Street, Boston, Mass. Joseph Nisbet LeConte, instructor in electrical engineering, State University, Berkeley, Cal. Hermann Loewenherz, mechanical engineer, Met. Tel. and Tel. Co., 18 Cortlandt St., New York City; residence, 311 Hudson St., Hoboken, N. J. Robert C. MacCulloch, manager, Jos. Lough Electric Co., 508 Fifth Ave.; residence, 407 J. Lexington Ave., New York City. Maxwell M. Mayer, manufacturer of dynamos and motors, 411 107th St., E. R.; residence, 242 E. 114th St., New York City. J. T. Nyhan, superintendent and electrician, Macon and Indian Spring Electric Railway, Macon, Ga. B. C. Paddock, Jr., assistant in Generating Dept., Edison Elec. Illuminating Co. of Boston; residence, Brookline, Mass. J. Lloyd Prince, engineer, Brooklyn (N. Y.) Water Works; residence, 868 Flatbush Ave., Flatbush, N. Y. Geo. A. Redman, general supt., Electric Dept., Brush Elec. Light Co., and Rochester Gas and Elec. Co., Rochester, N. Y. Bernard Victor Swenson, instructor in electrical engineering, University of Illinois, Champaign, Ill.

The following Associate Members were transferred to membership:—James Wellington Crosby, electrical engineer, Hix, Crosby & Co., New York City. E. Randolph Hix, firm of Hix, Crosby & Co., New York City. C. O. C. Billberg, electrical engineer, Thos. H. Dallett & Co., Philadelphia, Pa. James Halley Craig, firm of Cumner, Craig & Co., Boston, Mass. Edwin C. Shaw, manager, Akron General Electric Co., Akron, O.

At the meeting of the institute held at 12 West 31st Street in the evening Mr. H. Ward Leonard presented a most interesting paper entitled "Notes on Recent Electrical Engineering Developments in France and England."

The paper was discussed by Messrs. Townsend Wolcott, J. W. Lieb, Jr., C. E. Emery, Herbert Lloyd, A. E. Kennelly, Wm. Maver Jr., M. W. Forney, Cary T. Hutchinson, Richard Fleming, Joseph Sachs, Profs. F. B. Crocker and E. J. Houston.

THE MANHATTAN ELECTRIC STORAGE BATTERY COMPANY of New York City, has been formed to manufacture and sell electric storage batteries or accumulators, and any appliances connected therewith; capital, $600,000; Directors—August Belmont, James H. Hoffman, Louis Stein, Lewis May, and Ignatz Boskowitz of New York City.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEB. 26, 1895.

Alarms and Signals:—

Automatic Alarm Check and Guard, A. F. Carpenter, St. Louis, Mo., 534,631. Filed May 31, 1894.
Refers to an automatic guard for the alarm mechanism to prevent its accidental operation by water hammer or hydraulic action in a pipe system. The water pressure is carried to the alarm check through an air chamber.
Fire Alarm-Telegraph System, C. A. Rolfe, Chicago, Ill., 534,671. Filed April 10, 1894.
A system in which the street box can be started from neighboring buildings.
Signaling System, C. H. Brace, Union City, Mich., 534,779. Filed Nov. 27, 1894.
Arranged to allow for a great number of different signals to be quickly set.
Electric Slot for Signals, J. P. Coleman, Swissvale, Pa., 534,815. Filed Sept. 27, 1893.
Details of construction relating to the electric slot signal system for railways.
Signal, E. H. Goodman, Pittsburgh, Pa., 534,826. Filed Oct. 23, 1894.
Incandescent lamps are arranged on the arms of a semaphore signal and lighted so as to give different combinations.
Electric Signaling Apparatus, B. J. Noyes, Boston, Mass., 534,908. Filed July 5, 1892.
Improvement on same inventor's patent No. 359,687.

Conductors, Conduits and Insulators:—

Connector for Electric Conductors, R. D. Titcomb, Schenectady, N. Y., 534,732. Filed Dec. 21, 1894.
The ends of the conductors are slotted and made interchangeable.
Method of and Apparatus for Insulating Electrical Conductors, L. W. Downes, Providence, R. I., 534,785. Filed Aug. 22, 1894.
Covers the conductor with an adhesive substance wraps, asbestos fibre thereon, cards the latter and then compacts the fiber.
Apparatus for Manufacture of Insulated Electrical Conductors. L. W. Downes, Providence, R. I., 534,786. Filed Dec. 11, 1894.
Relates to details of the above.

Distribution:—

Electric-Current Transformer, J. A. G. Trudeau, Ottawa, Can., 534,678. Filed April 6, 1894.
Consists of a revolving commutator for converting alternating to continuous currents or vice versa.
Method of and Means for Preventing Magnetic Leakage, E. Thomson, Swampscott, Mass., 534,731. Filed Feb. 6, 1893.
Arranges adjacent to the primary and secondary coils of a transformer an accessory closed circuit, of low resistance so as not to be intersected by the lines of the primary field when this occupies its normal position, but to be cut by those lines when forced out of place by the counterfield of the secondary.
Driving Mechanism for Dynamos Located on Railway Cars, W. S. Bliss, Brooklyn, N. Y., 534,851. Filed Aug. 17, 1894.
Method of driving a dynamo placed upon the truck of a railway car.

Dynamos and Motors:—

Commutator, D. P. Thomson, Schenectady, N. Y., 534,739. Filed Dec. 17, 1894.
The commutator bar has a cut in its upper surface to which the connection of the armature wires are made.
Dynamo-Electric Machine, R. Eickemeyer, Yonkers, N. Y., 534,953. Filed June 7, 1888.
Refers to a winding for disc armatures.

Electro-Metallurgy:—

Manufacture of Articles by Electrodeposit, H. S. Anderson, Springfield Mass., 534,942. Filed Dec. 18, 1889.
Rotates the anode which is shaped to the profile of the object to be plated and surrounds the latter.
Concentrator and Amalgamator for Precious Metals, H. Baudouin & J. Southern, Grass Valley, Cal., 534,777. Filed June 14, 1894.
Claim 1:—
An apparatus for working the ores of precious metals, consisting of a vertically journaled oscillating pan having copper and zinc plates disposed therein with relation to each other so as to produce a galvanic action, the zinc plates being covered and protected from contact with the mercury by the copper plates.

Lamps and Appurtenances:—

Electric Arc Lamp, H. O. Swoboda, New York, N. Y., 534,677. Filed April 6, 1894.
Refers to a particular form of cut-out.
Electric Arc Lamp, J. Brockie, Forest Hill, England, 534,852. Filed Nov. 13, 1894.
Does away with the controlling or retarding mechanism influencing the carbons.
Lamp, H. E. Keeler, New York and W. S. Ham, Chicago, Ill., 534,888. Filed Sept. 27, 1894.
Combination of an oil lamp reflector and incandescent lamp.
Incandescent Light, H. F. Rooney, Randolph, Mass., 534,971. Filed Nov. 17, 1894.
Employs a reflector placed within the loop of the filament.

Measurement:—

Recording Watt-Meter, W. C. Fish, Lynn, Mass., 534,640. Filed Dec. 22, 1894.
An improvement on the Thomson meter. A U-shaped conductor forms the field winding, the armature being located within the bend of the U-shaped magnet; intended for heavy currents.

Miscellaneous:—

Electrically-Actuated Combination-Lock, S. L. G. Knox, Camden, N. J., 534,650. Filed April 13, 1894.
Electric Resistance Card, A. J. Shaw, Muskegon, Mich., 534,699. Filed Dec. 1, 1894.
Conductors are coiled or folded on a car and grouped in a frame insulated therefrom.
Electric Metal-Working Apparatus, H. Lemp, Lynn, Mass., 534,802. Filed Dec. 3, 1892.
Relates to details for preventing magnetic leakage, the prevention or contact of primary and secondary and for the carrying away of heat.
Electrical Lighting Device for Gas Engines, C. L. Ives, Grand Rapids, Mich., 534,866. Filed March 30, 1894.
Target-Trap-Releasing Device, B. O. Bush, Kalamazoo, Mich., 534,948. Filed May 14, 1894.
Electrically Operated Key Register, J. Kuff, New York, 534,961. Filed April 4, 1894.
Production of Artificial Crystalline Carbonaceous Materials, E. G. Acheson, Monongahela City, Pa. Reissue No. 11,473. Filed Jan. 23, 1893.
Refers to the production of carborundum. See THE ELECTRICAL ENGINEER, March 8, 1893.

Railways and Appliances:—

Railway Supply System, H. F. Gray, Passaic, N. J., 534,642. Filed Aug. 8, 1893.
The current is conveyed to the moving car by contacts slightly elevated above the roadbed.
Electric-Railway System, H. A. F. Petersen, Milwaukee, Wis., 534,662. Filed Nov. 8, 1893.
A conduit in which the conductors are placed in a separate compartment provided with covers which are removed as the car passes along and drop back after the car has passed.
Underground Conduit for Electrical Railways, H. A. Petersen, Milwaukee, Wis., 534,663. Filed March 26, 1894.
Similar to the above, the conduit being placed on the outside of the rail.
Clutch for Shafts, E. A. Sperry, Chicago, Ill., 534,676. Filed April 29, 1893.
Claim 1:—
A shaft coupling comprising an internally toothed gear wheel and a gear having the same number of teeth, but of smaller pitch diameter to engage and mesh with said internally toothed gear wheel, said gear wheel and gear being free to move relatively in a radial direction.
Battery System for Electric Railways, E. Julien, Brussels, Belgium, 534,834. Filed Dec. 9. 1886.
Improvement on inventor's previous patent covering method of charging and handling batteries for storage cars.
Electric Trolley Railway, J. M. Hammill, Aldan, Pa., 534,956. Filed Jan. 23, 1894.
Employs a conduit with a shield interposed between the slot and the conductor, the trolley wheel has insulating flanges and the trolley arm is bent around the shield.
Electric Brake, E. A. Sperry, Cleveland, Ohio, 534,974. Filed Jan. 30, 1894.
Refers to the brake described in THE ELECTRICAL ENGINEER, Sept. 26. 1894.
Apparatus for Arresting Motion of Electrically Propelled Mechanism, E. A. Sperry, Cleveland, Ohio, 534,975. Filed Feb. 5, 1894.
See above.
Electric Brake, E. A. Sperry, Cleveland, Ohio, 534,977. Filed June 8, 1894.
See above.
Conduit Electric Railway, M. F. Flynn, Stamford, Conn., 534,986. Filed May 24, 1894.

Telegraphs:—

Printing-Telegraph, S. V. Essick, Brooklyn, N. Y., 534,639. Filed Sept. 18, 1890.
Details of construction, improvements on previous patents.
Telegraph and Telephone System, C. A. Rolfe, Chicago, Ill., 534,670. Filed Sept. 16, 1893.
Employs a neutral line parallel with the closed metallic circuit which is connected to either one of the legs of the latter, according to the working conditions of the line.
Telegraph and Telephone System, C. A. Rolfe, Chicago, Ill., 534,970. Filed Feb. 15, 1893.
A combined system of telegraph and telephone for police purposes.

PERSONAL.

MR. A. J. DE CAMP, so well known in electric lighting circles, and long prominent in the affairs of the National Electric Light Association, has been elected a member of the new City Council of Philadelphia.

MR. LOUIS J. MAGEE.—Advices from Berlin, Germany, report the marriage there on February 16, of Mr. Louis J. Magee to Miss Virginia Phœbe Kent. Mr. Magee has long represented Thomson-Houston interests in the north of Europe. His host of friends in America will rejoice to learn that he has found consolation in his exile, and will extend to the happy pair their heartiest congratulations.

LEGAL NOTES.

IN THE ENGLISH LAW COURTS.

The Lord Chief Justice has given permission for the placing of a telephone transmitter in the Royal Courts of Justice, in London, to enable solicitors and others interested in cases tried in the court to listen to what is going on while at a distance. The test is at present confined to the Lord Chief Justice's own court, but if it proves successful, telephones will shortly be introduced into other courts. In this way great economy of time will be effected, with corresponding benefit to litigants and their lawyers.

GOOD WILL OF THE KNAPP ELECTRICAL WORKS.

The Electric Appliance Company, Chicago, have purchased of H. P. Lucas, receiver, the catalogue, good will and a large part of the stock of the Knapp Electrical Works, (insolvent) and are prepared to fill all orders for "Knapp" specialties promptly from Chicago stock. The Knapp Electrical Works catalogue is one of the largest, most complete and expensive electrical supply catalogues ever published. The Electric Appliance Company are making some revisions and additions to the original volume, making it even more complete, and are now prepared to furnish it on application together with a new special discount sheet, quoting exceptionally low prices. To those who are now in possession of a copy of the Knapp catalogue they are prepared to send a new discount sheet, making prices which they claim, will "get the business."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

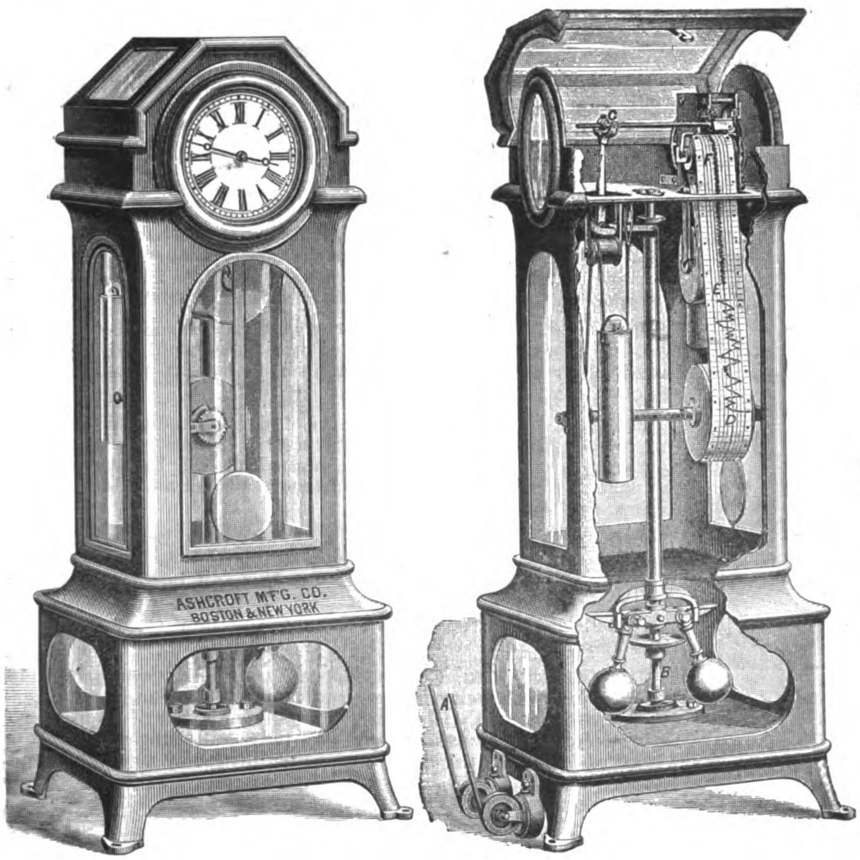
THE MOSCROP CONTINUOUS RECORDER FOR STEAM ENGINES AND STATIONARY MOTORS.

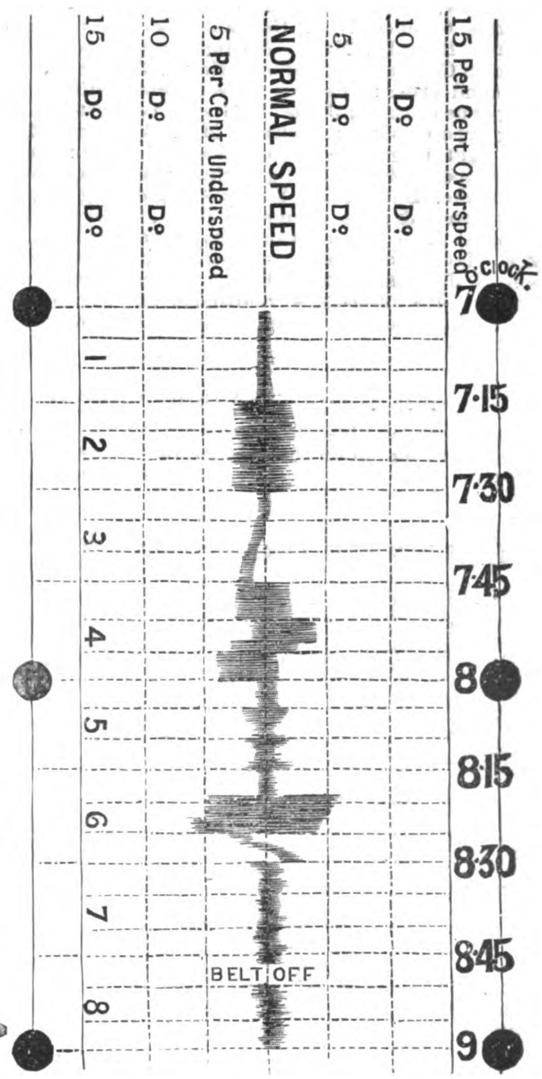
As steam engineers know to their cost the even running of an engine is not necessarily assured when the fly wheel makes the required number of turns a minute. Sixty revolutions a minute may be far from one revolution a second, and all engines oscillate more or less above and below their normal speed. The Ashcroft Manufacturing Co., of 111 Liberty street, New York City, manufacture the Moscrop continuous recorder designed to give an accurate diagram of the working of the engine from the time of starting. It automatically registers all variations from the standard speed, the exact moment that such irregularities take place and the time of stopping the engine.

The recorder is shown in the accompanying illustrations, Figs. 1 and 2. It consists of an iron case with glass sides containing an eight day pendulum clock which moves a continuous paper band upon which the autographic record is made by an inked marker actuated by the rise and fall of a pair of governor balls. The belt A, Fig. 2, from the shaft whose revolutions are to be recorded is brought under the idler pulleys at the back of the instrument to a horizontal pulley secured to the lower end of the shaft B, speeded to about 90 revolutions a minute. To this shaft are secured the governor balls whose rise and fall is transmitted through a sleeve, as shown, to the bell crank C, which actuates an arm carrying a marker. At the standard engine speed this marker rests upon the central longitudinal line of the paper, D. In Fig. 2 a record of uneven speed is shown from D to E, while from E to F is shown a record of uniform speed.

Fig. 3 shows a copy of an actual record which illustrates the work of the recorder. From 7 o'clock to 7.15 the record shows an almost perfect action of the engine both as to governing and fly-wheel momentum; from 7.15 to 7.30 the governing is still good but the fly-wheel momentum is small, the record showing an unsteadiness of 5 per cent. During the next fifteen minutes the fly-wheel momentum is excellent but the governing is imperfect and the speed has been reduced. From 7.45 to 8 o'clock both the fly-wheel momentum and governing are bad. This would show a too sudden change of load. And so on, until at 8.45 the record shows that the engine stopped through the slipping of the belt.

The regulation of pressure on electrical circuits always presupposes steadiness in engine revolution, and any variation from the normal speed produces annoying and wasteful results. If the speed decreases and hence the E. M. F. drops, the lamps fall off in brilliancy and call forth complaints from customers; while if the speed is too high even for a comparatively short period the E. M. F. at the lamp terminals runs them above their normal candle power and shortens their life correspondingly. Now that recording electric pressure gauges and recording steam gauges have come to be recognized as essential as a check upon the firemen and dynamo attendants it is but a logical step to bring the engine under similar supervision and thus enable the station manager to fix the responsibility for any irregularity in the operation of the station. The Moscrop speed recorder is admirably adapted for this purpose as shown by the record section below, and by the record made on it at the station of the Chicago Edison Co., which we published in our last issue.





FIGS. 1, 2 AND 3.—THE MOSCROP RECORDER AND A SECTION OF ITS RECORD.

ECONOMY FROM EXHAUST STEAM.

Messrs. Warren Webster & Co. of Camden, N. J., have issued a small volume of 128 pages, treating of exhaust steam utilized to effect economy or increase of power, and showing how these ends may be accomplished by the use of the Webster vacuum feed water heater and purifier. Having become fully established in their new works the firm state that they are in position to cover the entire heating subject. Nearly 100 pages of the pamphlet are devoted to testimonials from users of the Webster apparatus.

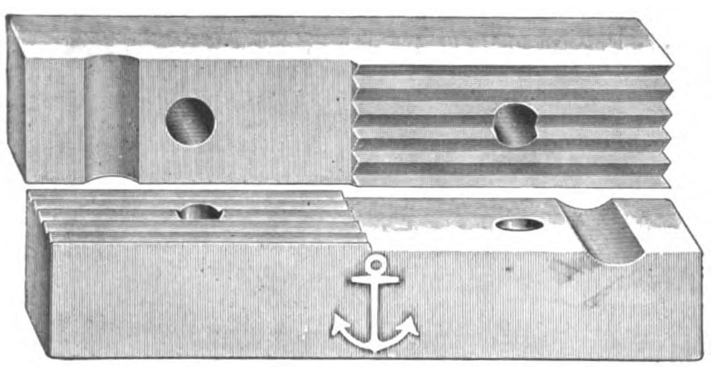
C. C. CLARK & Co., 519–20 Mutual Life Building, Philadelphia, are making a specialty of complete steam plants, for which Mr. Clarke's long and ripe experience admirably qualifies them. They are manufacturers also of the Morse copper tube horizontal and vertical feed water heaters and purifiers for either exhaust or live steam; and handle high grade water tube and tubular boilers, stacks, water towers, etc. The Morse heater is a meritorious device, and has already been adopted in twenty states as well as Canada and Mexico.

MATHER, MORE, MOST.

The Mather Electric Company, of Manchester, Conn., report a continuation of the unprecedented amount of new business secured. The following sales have recently been made through their isolated lighting plant:—The Berlin Iron Bridge Company, East Berlin, Conn., Second order—250 light ring type dynamo; Perkins Electric Switch Mfg. Company, Hartford. Conn., 350 light ring type dynamo; Haverhill Paper Company, Bradford, Mass., 150 light ring type dynamo; Inter-Mountain Electric Company, Pocatello, Idaho, 450 light ring type dynamo; Hub Gore Makers, Brockton, Mass., 450 light ring type dynamo; Coffee Exchange, New York City, 600 light ring type dynamo; Iroquois Furnace Company, 150 light ring type dynamo; Cranston Worsted Mills, Bristol, R. I., 250 light ring type dynamo; Hub Gore Makers, Camden, N. J., 150 light ring type dynamo; New Opera House, Holyoke, Mass., 250 light ring type dynamo; Waverly Woolen Company, Pittsfield, Maine, 350 light ring type dynamo —second order; Thatcher Bros., New Bedford, Mass., 100 light ring type dynamo; James F. Grant, Youngstown, Ohio, 450 light ring type dynamo; Rockwell Mfg. Company, Milwaukee, Wis., 100 light ring type dynamo—second order; Burtis & Howard, Minneapolis, Minn., 100 light ring type dynamo—third order; S. H. Blake, Elmira, N. Y., 2–250 light ring type dynamos; B. Lowenstein & Bros., Memphis, Tenn., 100 light ring type dynamo; Straight Line Engine Company, Straight Line, New York, 20 K.W. Manchester type generator; Cook Locomotive Works, Paterson, N. J., 45 K.W. 220 volt multipolar generator; J. Holt Gates, Chicago, Ills., 2—60 K.W. multipolar generators, 500 volts. Denison Light & Power Co., Denison, Tex., 45 K.W. multipolar generator 220 volts.

THE ANCHOR CLEAT.

The accompanying illustration shows the new "Anchor" cleat which is being put on the market by the Anchor Electric Co., of Boston. As will be seen, both halves of the cleat are precisely



THE ANCHOR CLEAT.

alike, and the wire is prevented from slipping by the corrugations in the porcelain. The cleat is strong, reliable and equally suitable for heavy or light work.

POSTAL TELEGRAPH CO.'S AFFAIRS.

At the annual meeting of the Postal Telegraph Company these directors were elected: Albert B. Chandler, John W. Mackay, Jr., George S. Coe, W. C. Van Horne, James W. Ellsworth, Charles R. Hosmer, George G. Ward, William H. Baker, Edgar C. Bradley, E. C. Platt. The annual report shows 1514 miles of pole line constructed during the past year, and 6888 miles of wire (mostly copper) strung. A second route to the Pacific coast of two copper wires, 300 pounds to the mile, via Colorado, New Mexico, Arizona and Southern California was also constructed.

NEW ENGLAND NOTES.

THE ANCHOR ELECTRIC Co., of Boston, have recently acquired the sole agency for the United States for the Dow adjuster for incandescent lamps, and have also secured the agencies for New England, of the Helios Electric Co. of Philadelphia, manufacturers of the Helios arc lamps, and the Marietta Mfg. Co. of Lancaster, Pa., manufacturers of the well-known Crescent ceiling fan. Business with this enterprising firm appears good and distinctly on the increase.

CHARLES E. NORTON, of Manchester, Conn., has recently put on the market a very neat and reliable voltmeter and ammeter, which is meeting with considerable success. Mr. Norton has been engaged in the manufacture of instruments for years, and understands this branch of the electrical business thoroughly. He will be glad to have agents in the chief large cities, and would like to hear from any responsible company desiring such an agency, for the purpose of making arrangements as to handling them.

THE JEWELL BELTING Co. of Hartford, Ct. in spite of the dull times, were never so full of orders for large belts for electrical work as at present, which speaks well for the quality of their goods. On a recent visit to their factory the writer saw a large number of these belts in process of manufacture and the following list will prove interesting to purchasers of this article. The 78 inch belt which heads the list, will, when completed, it is claimed, be the largest belt in the world, an honor which many companies have ever been striving after.

118 feet	78	inches	4 ply.	115 feet	24	inches	double.
$105\frac{4}{12}$ feet	62	"	3 "	58 "	24	"	"
$105\frac{4}{12}$ "	62	"	3 "	92 "	40	"	"
$88\frac{4}{12}$ "	62	"	3 "	99 "	26	"	"
$88\frac{4}{12}$ "	62	"	3 "	90 "	36	"	"
$88\frac{4}{12}$ "	62	"	3 "	113 "	40	"	"
110 "	34	"	3 "	136 "	36	"	"
117 "	42	"	double.	130 "	24	"	"
67 "	30	"	"	86 "	26	"	"

NEW YORK NOTES.

THE ONONDAGA DYNAMO Co. of Syracuse has been formed, to make and sell dynamos, etc. It has a capital stock of $25,000. The directors are E. H. Eager, J. W. Eager and D. Cronin.

MR. E. S. W. MOORE, the electrical engineer of the Elwell-Parker Elec. Co., of Cleveland, was a visitor to the East last week, making a study of the situation and inspecting plants, &c.

THE BABCOCK & WILCOX Co., of this city, announce the appointment of Mr. W. T. Bonner as their general agent for Canada, in place of Mr. E. C. French, resigned. Mr. Bonner's headquarters will be 415 Board of Trade Building, Montreal.

MR. W. B. VANSIZE, counselor at law, patent solicitor and expert, has removed his office to the Postal Telegraph Building, 253 Broadway, where he will carry on an independent agency in the various departments named.

THE F. E. BELDEN MICA MINING Co. of Boston, miners of mica and dealers in it; manufacturers also of ground mica, quartz, flint and silex, have established a branch at 182 Franklin street this city, where all their products may be found. Mr. Union Adams, Jr., is their agent.

THE JAEGER ELECTRIC LAMP COMPANY has been organized with a capital stock of $10,000 to manufacture series miniature incandescent lamps. The officers are Herman Jaeger, president; N. D. Webster, vice-president and secretary, and Louis J. Auerbacher, treasurer. The office of the new company is at 136 Liberty street, New York city.

THE GOULDS MFG. Co., of Seneca Falls, N. Y., warerooms, 16 Murray Street, this city, have issued a superb and intensely interesting catalogue of their work. It is nothing short of an authoritative volume on all branches of pumping and pump work. It is a book of about 350 pages, cloth bound, profusely illustrated and full of valuable data on subjects of interest to the electrical, hardware, plumbing, agricultural and other trades.

THE LAW BATTERY Co. finds itself at Springtide with a remarkable activity in business and with orders flowing in briskly. They have been compelled to work nights—a phenomenon regarded with much envy by a good many other establishments in their neighborhood. Mr. Jones, who is in charge at their well known headquarters at 85 John Street, looks forward to a solid trade through the year. The merits of the Law battery and other Law specialties are familiar to all in the electrical trade; and with recognized standard goods, the Company will benefit steadily by the reputation it has won through so many years. The Law batteries in use to-day are well nigh countless.

WESTERN NOTES.

THE NUTTING ELECTRIC Co., Chicago, have increased their capital stock from $50,000 to $100,000.

THE HENRY FIRE & POLICE ALARM Co. has been incorporated at Chicago for the purpose of manufacturing fire and police alarms. The incorporators are E. B. Chandler, C. A. Rolfe, F. C. Stover, J. W. Stover and Wm. H. Woolverton.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

EXTRA.

The Electrical Engineer.

MARCH 6, 1895.

DECISION IN BATE CASE.—INCANDESCENT LAMPS FREE.

SUPREME COURT OF THE UNITED STATES.

No. 687, October Term, 1894.

THE BATE REFRIGERATING COMPANY, APPELLANT, *vs.* SULZBERGER, *et. al.*—AN AMERICAN PATENT EXPIRES WITH THE EARLIEST FOREIGN SIMILAR PATENT REGARDLESS OF DATE OF APPLICATION.

JUSTICE HARLAN DELIVERED THE OPINION FOR THE COURT, March 4, 1895.

ON the first day of December, 1876, Bate made application to the United States for Letters Patent for an Improvement in Process for Preserving Meat During Storage and Transportation. Before this application two foreign patents were granted for the Bate invention, one for the term of fourteen years by the British Government to William Robert Blake on a communication from Bate under date of January 29, 1877, which was sealed July 13, 1877, and the present application was filed July 26, 1877. The other for a term of five years by the Government of the Dominion of Canada to Bate himself under date of July 9, 1877. After these foreign patents were issued, namely, on the 20th day of November, 1877, Bate received a patent from the United States expressed to be for the term of seventeen years, and assigned it to The Bate Refrigerating Company, the plaintiff in this suit.

The present suit was brought by that Company July 25, 1892, for an injunction against the infringement of the American patent, and also for an accounting. It was set down for hearing in the Circuit on pleas and the bill was passed dismissing the suit. From that decree the case was taken to the Circuit Court of Appeals.

Both foreign patents of the Bate invention having expired before the expiration of the seventeen years specified in the United States patent, the following question arose in and having been certified before the Circuit Court of Appeals whether the invention for which the patent from the United States was issued had been "previously patented in a foreign country" within the meaning of those words in Sec. 4887 of the Revised Statutes, and whether the American patent expired under the terms of that section before the expiration of seventeen years from its date.

* * * * * * * * * *

The plaintiff insists that under a proper construction of the statutes, an invention patented, or caused to be patented, in a foreign country, before being patented in this country, should not be deemed to have been "previously patented in a foreign country" unless the foreign patent was issued prior to the application for the American patent.

The defendants contend that the respective dates of the American and foreign patents, and not the date of the American application, determine the question whether the invention patented here has been "previously patented in a foreign country."

* * * * * * * * * *

The Court reviewed acts of Congress commencing with the one of April 10, 1790; February 21, 1793; April 17, 1800; July 13, 1832; July 4, 1836; March 3, 1839; March 6, 1861; July 8, 1870, and said:—

From this history of the several Acts of Congress relating to patents for the inventions before referred to, it appears:

1. That in all the above Acts Congress had in mind the date of an application for a patent; the date of filing of specifications, and the date of the patent.

2. That under the Act of 1836 a patent could not be granted if it appeared that the application was not an original first invention or discovery, or that any part of that which was claimed as new had been before invented or discovered, or patented, or described in any printed publication in use in this or any foreign country; yet an original and true inventor was not to be deprived of a patent for his invention "by reason of his having previously taken out Letters Patent therefor in a foreign country, and the same having been patented at any time within six months next preceding the filing of his specifications and drawing.

3. That under the Act of 1839 an inventor * * * * * * should not be debarred from receiving a patent by reason of his invention having "been patented in a foreign country more than six months prior to his application."

4. That by the Act of 1870 the Act of 1839 was not qualified by reference to the date of application.

5 Reference to Acts of 1839 and 1870.

6. Reference to the question of granting a United States patent notwithstanding prior foreign patents, but limited to expire with foreign patent, etc. * * *

The decisions of the Commissioner of Patents in several cases within a few months, after the Act of 1870, were upon this point. These decisions, were important because rendered after the changes made to Act of 1870 in cases of those who like Commissioner Fisher took special interest in legislation affecting patents.

The Court referred to Mushets' case, decision Sept. 19th, 1870; Boyer's case October 25th, 1870; Smith vs. Skinner Oct. 26th, 1870.

The decision then refers to course of judicial decisions upon this question:

First. Bate Refrigerating Company vs. Gillett, 13 Fed. Rep. 553: Judge Nixon: also Gramme Electrical Company vs. Arnoux etc. Electric Company, 17 Fed. Rep. 838; Bate vs. Gillett before Mr. Justice Bradley: Edison Electric Light Co. vs. United States Electric Lighting Co., 35 Fed. Rep. 134, decision by Judge Wallace. (Several other decisions are referred to, all interpreting the Act in the same way), and goes on:—

In view of this history of the question presented by the certificate of the Circuit Court of appeals, what is the duty of this Court?

In Andrews vs. Hovey, 124 U. S., 694, it was said that the construction of the statute of the United States concerning patents for inventions can not be regarded as judicially settled until it has been so settled by the highest judical tribunal which can pass judgment upon the question.

* * * * * * * *

The appellant therefore properly insists that the determination of the present question shall not be deemed absolutely concluded either by the practice which has obtained in the Patent Office since the passage of the Act of 1870, nor by decisions in the inferior courts of the United States. If Sec. 4887 of the Revised Statutes is so worded as to express clearly the intention of Congress, the duty of this Court is to give effect to that intention; but even if the statute is not so explicit as to preclude construction, if upon applying to it the easy rules of construction; if looked at in the light of previous legislation on the subject; if there be reasonable ground for adopting either one of the two constructions; this Court without departing from sound principle may well adopt that construction which is in harmony with the settled practice of the Executive branch of the Government, and with the course of judicial decisions in the Circuit Courts of the United States; if there be reason to suppose that vast interests may have grown up under that practice and under judicial decisions which may be disturbed or destroyed in consequence of a new rule. ° ° *

It has already been observed that statutes relating to patents show upon their face that Congress always had in mind the difference between an application for a patent and the patent itself; and that difference is apparent in the Act of 1870. We find there the words "Application," "patent," "patented," "first patented," "caused to be patented."

We cannot superadd in Section 4887 of the Revised Statutes the words "prior to the application" either after the words "first patented or caused to be patented in a foreign country," or after the words "previously patented in a foreign country," without deviating from the intention of Congress as manifested by the language it selected to indicate its purpose. And the express command of the existing statute is that every American patent for an invention "previously patented in a foreign country," that is, "first patented or caused to be patented in a foreign country" shall expire at the same time as the foreign patent. No words are used that will justify the Court in holding that an invention

patented in a foreign country before being patented here is to be exempt from the operation of the provision limiting the term of the American patent to expire with the foreign patent.

Was the Bate invention patented abroad before it was patented in this country? If so, the American patent expired with the foreign patent, and therefore the American public became entitled to use the invention from the time the foreign public were permitted to use it. Congress in effect by the existing law says to the inventor in order to enjoy the exclusive use in this country of his invention for the term prescribed by law "if your invention has not been introduced into public use for more than two years you may, upon complying with the conditions prescribed, obtain an American patent, and you may, if you can, obtain a foreign patent. But the American patent will be granted on the condition that if you obtain a foreign patent first your invention shall be free to the American people whenever by reason of the expiration of the foreign patent it becomes free to people abroad; but in no case shall the term of the American patent exceed seventeen years." This we deem to be a sound interpretation of the statute giving to the words used the meaning required by their ordinary signification. In our judgment the language used is so plain and unambiguous that a refusal to recognize its natural meaning would be justly regarded as indicating a purpose to change the law by judicial action based upon the supposed policy of Congress. But as this Court well said in Haddon vs. Collector, 5 Wall. 107: "What is termed the policy of the Government with reference to any particular legislation is generally a very uncertain thing, upon which all sorts of opinions are founded by different persons. It is a ground much too unstable upon which to rest the judgment of the Court in the interpretation of statutes." "Where the language of the Act is explicit" this Court has said "there is great danger in departing from the words used to give an effect to the law which may be supposed to be designed by the legislature. * * * * * * It is not for the Court to say where the language of the statute is clear that it shall be so construed as to embrace cases because no good reason can be assigned why these were excepted from its provisions." Denn. vs. Reid, 10 Pet. 524–527.

Undoubtedly the Court when endeavoring to ascertain the intention of the Legislature may be justified under some circumstance in giving weight to considerations of injustice or inconvenience that may arise from a broad construction of the statutes. It is therefore said that the time ordinarily intervening in other countries between the filing of application and the granting of the patent is very short in comparison with the time ordinarily consumed in this country in obtaining a patent after the inventor has filed his application in the Patent Office, and consequently the statute, if considered as we have indicated, these words may operate greatly to the injury of the American inventor in that he will be deprived of so much of the statutory term of his American patent as will be in excess of the term of any foreign patents previously obtained upon the same invention. If the statute thus construed does not give to the inventor all the benefits he would like to have, the remedy is with another Department of the Government, and it is not for the Courts to tamper with the words of the statute or put a strained construction on a legislative enactment whose language is clear and explicit to accomplish a result not contemplated by Congress.

This Court spoke by Chief Justice Marshall in United States *vs.* Fisher, that where the meaning of the legislature was plain it must be obeyed.

The Court then reviews the principle of limiting American patents to expire with previous foreign patents as it appears in the earlier acts. The Court then refers to the allegation that the United States promises an inventor seventeen years protection, provided it was found that he was so entitled to the same at the time of such application. But "if the promise to issue a patent is made with a reservation in the statute containing the promise that the patent when issued shall be limited to expire with any foreign patent previously issued for the same invention, then there is no basis for the suggestion that the enforcement of that condition violates any promise made to the inventor."

"We think that the words used in Section 4887 of the Revised Statutes, as well as those in Section 25 of the Act of 1870 clearly evince the purpose of Congress to regulate the term of the American patent (where the same invention has been patented abroad) so that it will expire at the time the foreign patent expires, even if the latter was applied for and granted after the filing of the American application or before the American patent issues.

The Court then considered the contention regarding the proceedings in Congress relating to the bills which have numerous amendments, the Act of 1870, and also the observations made by Mr. Jenckes when reporting that bill.

"These considerations, it is supposed, should have controlling weight in our interpretation of the Act as finally passed. We cannot assent to this view. * * * *"

A good deal has been said about the intention of Congress as manifested by its legislation to deal liberally with inventors, especially those who were citizens of the United States. This is true, but it is for Congress to prescribe the conditions upon which it will secure to inventors the exclusive right to his inventions. What may be due to inventors is a matter about which there may well exist differences of opinion. It is for the legislative branch of the Government to say when a patent to the inventor shall expire, and therefore, when the public may enjoy without charge the benefit of the invention covered by it. We can very well understand how the existing statute may under some circumstances operate injuriously to the inventor. He, in addition to exclusive rights granted to him in this country for the term of seventeen years, wishes to secure a monopoly for his invention in other countries, and if he obtains foreign patents for the invention before obtaining one here, the American patent is limited by law, whether it is so expressed or not in the patent: it is to expire with the foreign patent of the shortest term. This is the case as it appears from the standpoint of the patentee without regard to the interests of the American public.

But is it to be remembered—at least it may be assumed that Congress so intended—that action by the Patent Office upon applications for patent was often unduly and purposely delayed by applicants until they could reap the full benefit of the monopoly by them in foreign countries before taking out an American patent. "In the mean time" the Commissioner of Patents in his annual report as late as 1887 said that "they (applicants for American patents) are engaged in the manufacture and putting upon the market the article or improvements, but warning the public that the patent is applied for, the effect of which is to give them the absolute control and monopoly of the invention and to deter all other inventors from entering upon the same field of invention and from manufacturing the article." * * *

"If this apparently operates harshly upon inventors (the expiration of the American patent) it is for Congress, whose discretion is not subject to judicial control, to make provision for this, because, if it be possible to do so, such injury to the people of our country should no be inflicted upon them.

"And it may be said in this connection that Congress allowed the 25th section of the Act of 1870 to stand, although the Commissioner of Patents immediately after the passage of that Act, ruled that it had changed the prior law so as to limit the American patent to expire at the same time with the foreign of the shortest term covering the same invention, and issued before the American patent, although after the application therefor was made. If, as is insisted, the change was not intended and was effected only by words carelessly used and not purposing to introduce a new rule for the limitation of the term of the American patent, some action on this subject, it may be assumed, would have been taken by Congress after the passage of the Act of 1870.

The Revised Statutes of 1874 were adopted with the knowledge, it must be presumed, on the part of Congress of the construction previously placed by the Patent Office upon the 25th section of the Act of 1870. This presumption is strengthened by an examination of the Act, approved February 18, 1875, entitled "an Act to correct errors and to supply omissions in the Revised Statutes." That Act upon its face shows that the revision of 1874 was carefully considered after it was adopted for the purpose of ascertaining whether errors or omissions in the work of revision had been committed. Now it is inconceivable that the addition in the wording of the 25th Section of the Act of 1870 or of Section 4887 of the Revised Statutes when compared with the Act of 1889 could have escaped the attention of Congress, especially as the Act of 1870 had been interpreted as introducing a new rule in respect to the term of American patents where the same invention was covered by a foreign patent previously issued. The Act of 1875 for the purpose of correcting errors and omissions amends nearly 70 sections of the Revised Statutes. But there is no alteration of Section 4887.

Still further—as an examination of the statutes will show—since the Revised Statutes went into operation more than 750 Sections other than those referred to in the Act of 1875 have been amended or repealed, but no amendment has been made to Section 4887.

The rule prescribed by the 25th Section of the Act of 1870 having been reproduced in Sec. 4887 of the Revised Statutes, and the latter section never having been amended, we ought not after the lapse of nearly twenty-five years from the passage of the Act of 1870 place upon its 25th Section, or upon Section 4887 of Revised Statutes, which takes its place, an interpretation other than that which the ordinary natural meaning of their words import.

Our answers therefore to the questions certified are, that the invention for which United States patent to Bate was issued under the facts stated, was "previously patented in a foreign country," within the meaning of those words in Section 4887 of the Revised Statutes, and that the United States patent to him expired under the terms of that section before the expiration of seventeen years from its date.

Let it be so certified to the Circuit Court of Appeals.

THE
Electrical Engineer.

Vol. XIX. MARCH 13, 1895. No. 358.

THE INDUSTRIAL USE OF MOTORS ON POWER CIRCUITS, OPERATED BY THE STREET RAILWAY COMPANY, AT LOS ANGELES, CAL.

BY

George Heli Guy.

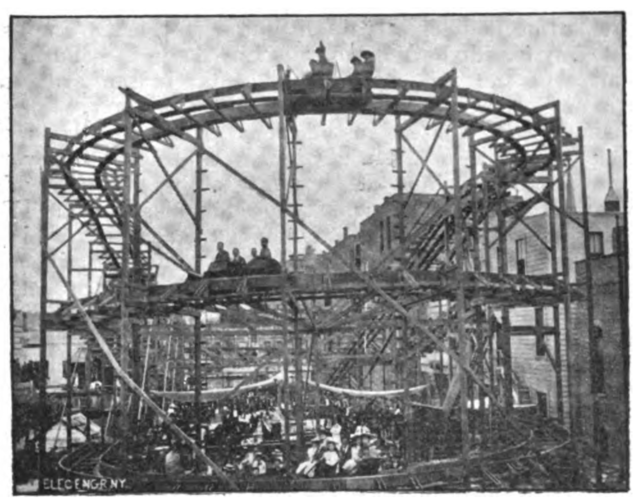
INDEPENDENTLY of its extensive street car system, the Los Angeles Consolidated Electric Railway Company supplies 240 horse-power to users of small units within the city, who would otherwise be hampered by the cost of fuel. The greater part of this 240 horse-power is utilized in operating hydraulic elevators. A notable example of this application is found in the Wilson Block office building, at the corner of First and Spring streets. In a combined 8 H. P. motor and pump, made by the Electrical Engineering Co. (Keith patents), of San Francisco, the motor is placed on an extension of the bed plate. This pump supplies the "accumulator," and is belted direct to the motor, which acts automatically. When the pressure on the "accumulator" reaches 100 pounds, the motor is automatically cut off, and its action is suspended until the pressure drops to 80 pounds, when it again comes into operation. By this arrangement the motor is at rest fully half the time, and there is a great saving in current consumption, and consequently a reduction in cost of operation. The elevator carries 4,000 passengers daily, for six days in the week. No countershaft is required, and while the belt is short, ample pulley contact is secured to prevent belt slipping. The motor took the place of a steam plant, which required the constant attendance of an engineer. The whole plant is now kept in order by the janitor of the building, and the pay of a skilled engineer is thus saved.

In the Stowell block, a large and handsome modern office building, a 15 H. P. Otis-Eickemeyer motor is connected direct to the elevator. The building is fully tenanted and the elevator carries 1500 pounds 150 feet per minute. Less than 3 horse-power is required on an average to run the plant. This application of the electric motor is now made in the principal hotels and public buildings in the city. The ability to dispense with a fireman and an engineer appeals forcibly to managers of both public and commercial departments, and the service is singularly pleasing and attractive to the public. Indeed, it is stated, as a well authenticated fact, that the adoption of the electric motor in elevator plants in Los Angeles has invariably been quickly followed by a large increase, in the majority of cases more than double, of the passenger traffic. In the case of the Wilson Block, when the elevator was operated by steam the service in the building was very limited; it was, in fact, so irregular that people found it less trouble to walk upstairs than to wait for the elevator. Immediately on the introduction of the electric motor the traffic took a sudden jump, and tenants, who had before been shy, flocked into the building, which is now entirely taken up.

The next largest utilization of the electric motor in the city is probably in meat markets, and the operation of cold storage plants. In the large factory of the Cudahy Packing Co., an 8 H. P. motor drives a dynamo and other small machinery in one of the shops. A 15 H. P. Sprague motor placed on the roof operates the hog hoist. A loop is slipped around the hog's leg, the motor switch is pressed, and in an instant the unfortunate victim is jerked up to a platform, where it is despatched by an attendant. In a second or two more, it has started on its varied mission of usefulness, by way of the boiling water tank. This is butchery highly refined, and it is certainly vastly less repellant than the methods which are now, fortunately, going out of vogue. A 3 H. P. motor works the elevator, and a 2 H. P. motor runs the machine for crimping the lard cans and covers.

In a prominent butcher's shop in East First St., a 10 H. P. Mather motor works a grindstone, a sausage machine and the fans for keeping the flies off the meat. In addition to these, the motor will shortly operate a refrigerator plant.

Another sphere of special usefulness of the electric



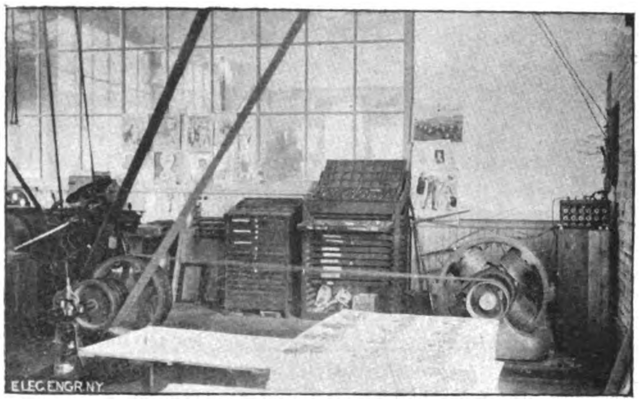
ELECTRIC TOBOGGAN SLIDE, LOS ANGELES.

motor is found in photo engraving, in which it is now almost universally adopted throughout the city. The Union Photo Engraving Co., under the management of Mr. Fred. J. Behre, has a 3-horse-power Thomson-Houston motor, for turning a circular saw, trimming plates, drilling, and operating the routing machine. The peculiar adaptability of the electric motor for this work is shown by the fact that the router requires a speed of 14,000 revolutions per minute. It is only by such excessive speed that the vibration which interferes with the needful accuracy of the work is overcome, and Mr. Behre says that it is by electricity alone that thoroughly satisfactory results can be attained in this branch of business. A larger motor is shortly to be installed, to work a Daniel's planer, a beveller, and other machinery.

The Lithographic Co. have a 15 H. P. G. E. multipolar machine for operating three large presses, and four small presses for job work, power cutters, trimmers, etc.; and the Pacific Engraving Co. claim that they have the only

engraving plant worked entirely by electricity in Southern California.

Another firm of engravers who owe much of their success to electrical power are the Kingsley, Barnes & Neuner Co., whose establishment also comprises a book binding and printing department. On the ground floor,



PRESS ROOM OF THE LOS ANGELES LITHOGRAPHIC CO.

an 8 H. P. motor works eight printing presses, while on the upper floor it actuates a copy cutter, two ruling machines, a wire stitcher and an emery machine. This is the largest and most successful electrical plant in the city. The finish, clearness and beauty of the half-tone work turned out by the firms devoted to it in this city is a revelation and a surprise. The explanation of this super-excellence given by the photo-engravers themselves is that Nature is distinctly in league with them. They say that they can do better work in Los Angeles—and in one quarter of the time—than they can do in San Francisco, or in any other city, west or east, in the country.

One of the neatest installations in the city is in the Post Office, where a ¼ H. P. Crocker-Wheeler motor works the stamping machine of Hey & Dolphin through which every letter delivered from the office is passed. The letters are stamped at the rate of 600 per minute, and the contrast between the old hand work and that given by the motor is striking. Since June last 6,000,000 letters have gone through the machine. There is no muddiness or uncertainty about the mark on the Los Angeles letters; a new stamp is put into the machine every day, and the work turned out is uniformly excellent.

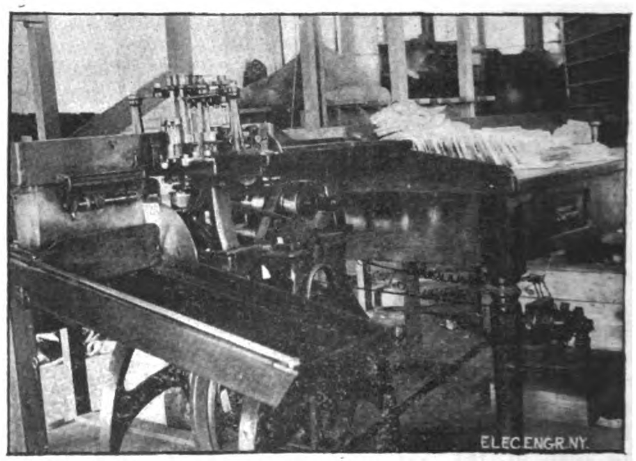
In the factory of H. Raphael & Co., glass bevellers and mirror and window manufacturers there is a suggestive sight. A little 6-horse Edison motor is busily turning the whole of the machinery for finishing the glass for various purposes. At one end is a "rougher," bevelling the glass with sand, another for bevelling with emery, then a "smoother"; then comes the stone for polishing with pumice stone, and finally the rouge polisher. In addition to this satisfactory performance, the motor works the elevator. Within a foot or two of the motor are the dismantled and forlorn remains of a 10 H. P. gas engine, which formerly did a share of the work now done by electric power.

Probably the most interesting plant in the city is that in the jewelry store of A. E. Marcher, where a 3 H.P. C. & .C motor is used in the cutting of precious stones. The machine worked by the motor is a new and most ingenious invention of Mr. F. A. Marcher, and it is the only one of the kind in the country. In the old method of cutting, the stone was centered on the end of a stick or piece of brass, and held by the end on the grinding lap. In Mr. Marcher's machine, the stone is held by a quadrant, which is adjusted by a set screw to its required position on the lap. As many as 60 stones can be cut at one time, and the method of adjustment is so accurate that in no case would there be the slightest possibility of overgrinding, even if an attendant were to leave the machine to look after other duties. This enables the cutting to be done with a certainty and minuteness impossible in any other way. The quadrants are all indexed to cut any style of stone, and an inexperienced operator can be taught in half an hour to do the work of 20 of the best skilled laborers in the country. This machine promises to revolutionize the gem cutting industry of the world.

Another notable application of electric power is seen in the rear of the store of Mr. S. G. Marshutz, the sole representative of the Pacific Optical Co., where a 1 H. P. San Francisco Electrical Engineering Co. motor runs a plant for grinding lenses for spectacles, surgical instruments, and all kinds of optical work. The outfit consists of four grindstones, one compound grinding lathe, one polishing machine, one grooving and one planishing machine. This is the only plant of the kind in Southern California, and it covers, in addition to the foregoing, the manufacture of spectacle frames, and every description of optical repairing. All the work now done by the grooving machine had formerly to be sent East or to San Francisco, to be done by hand by skilled laborers. The adoption of electric power by the Pacific Optical Co. has been followed by a remarkable expansion of its business.

A neat way of killing two birds with one stone is seen in the grocery store of Anderson and Chanslor. In the store window a 1 H. P. Crocker-Wheeler motor is surmounted by 5 incandescent lamps. The motion of the motor and the glow of the lamps draw a constant crowd, and form an effective advertisement. Just within the store, but out of sight, is a coffee grinding machine. This is kept briskly at work by the motor, which thus does what formerly required the services of a man at $30 a month. The employment of electric motors for the purposes of window display is quite a feature in the Los Angeles stores. At Christmas time a large clothing store distanced all competitors in this branch of spectacular art by fixing up in its window a large whale. The jaws of the animal were moved by a small electric motor, and when they were opened, far down within the capacious maw could be seen the effigies of Grover Cleveland and his cabinet in doleful dumps. A couple of policemen had to patrol the sidewalk to enable the traffic of the street to go on.

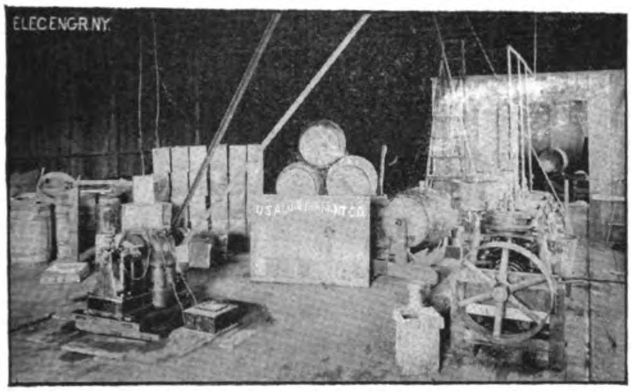
The Los Angelines can see the white capped head of



ELECTRIC CANCELLING MACHINE, LOS ANGELES POST OFFICE.

"Old Baldy" shining down from the top of the Sierra Madre nearly all the year round, but few of them have ever known such a thing as a businesslike fall of snow within the city limits. This, however, does not debar them from having their toboggan slide, and they appear to enter into the wild exhilaration of the downward rush of

the sled with much, if not all, of the zest experienced in climates where the normal register of the thermometer is something more or less below zero. But the toboggan slide, like almost everything else in Los Angeles, is run by electricity. A 7½ H. P. San Francisco Electrical Engineering Co. motor hauls the car, by means of a sprocket chain,



GRINDING PAINT BY ELECTRICITY.

to the top of an incline, 100 feet above the ground. The car is then turned loose on the track, which has an abrupt downward and circular winding sweep and the passengers shoot over the slide at an average rate of a mile a minute.

In the wholesale coffee and spice mills of G. H. Stoll & Co., a large steam plant has been superseded by a 6 H. P. San Francisco Electrical Engineering Co. electric motor, which operates a very compact outfit. The machinery comprises a coffee grinder, spice mills, rotary coffee roaster and coffee cooler. Great exactitude is required in the turning of the coffee roaster. Even as slight a variation in speed as two revolutions per minute would on the one side cause the coffee to "slop over," and on the other, to burn. The electric motor gives just what is needed, a uniform and accurately gauged motive power. The coffee cooler consists of a receiver into which the roasted berries are run, provided at one end with a rotary fan, which, rapidly revolving, draws the air through the hot coffee, and thus cools it. The whole process of transforming the raw berry into the product available for the breakfast table is carried on, without crowding or inconvenience in an apartment not exceeding 18 feet by 20, and the plant affords a good illustration of the saving in space, time and money that is effected by the use of the electric motor.

In the New York Kitchen Restaurant there is a suggestion, which deserves widespread recognition and imitation, for the cure of that bane of an extensive section of American social life, the pervasive smell of the kitchen. Formerly the odor of cooking was so intolerable that the business of the restaurant was seriously affected. Something had to be done, and the proprietor hit upon the electric exhaust fan, and found that his trouble had vanished. The fan, which is actuated by a small motor, draws up all the heated air and smells of the kitchen, and drives them up a shaft whence they escape into the outer air. The remedy is as effective as it is simple.

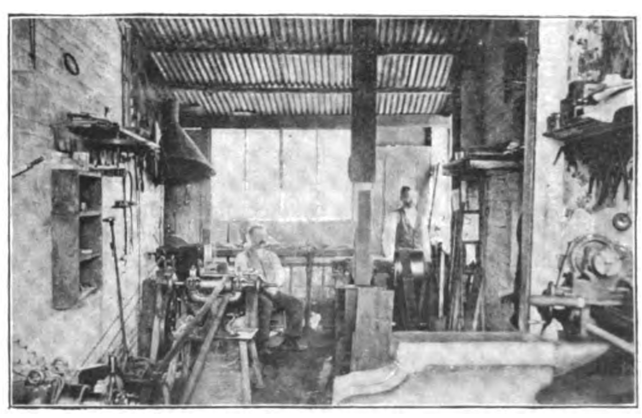
In a livery stable is a 1 H. P. Lundell motor is chopping hay and grinding grain for the horses, and a ½ H. P. Crocker-Wheeler is working a horse clipping machine. Formerly, when manual labor was employed, by the time a man had clipped three horses, he was played out, and had to be relieved. This brought the cost of the clipping to four of five dollars a day. Now, the clipping of any number of horses is a comparatively light and inexpensive task.

There is an important plant in the operating shop in the basement of the building of the Los Angeles Gas & Electric Fixture Co. A 7½ H. P. General Electric multipolar machine, drives the lathes, buffing machines, planer, and electroplating dynamo. This is the largest establishment of the kind in southern California. Mr. Max Meyberg, its able manager, has earned much local fame by his skillful organization of the "fiesta," which is now established in Los Angeles as the Carnival time of the year, when dull care is thrown away, and the whole city abandons itself to gaiety and enjoyment. The plant in this building illustrates another set of conditions under which the electric motor is without a rival. The noise of a steam plant would be prohibitive. Neither steam nor gas could be used, as the wreckage of valuable material in the floors above in case of explosion would be most disastrous without insurance, and if the stock were insured, the rates would be excessive.

Mr. L. Pedy, the representative of the French firm of P. Turon & Co., in East First Street, has taken the attractive title of "electric grinder." Mr. Pedy saw the electric cars in the street in front of his store, and it occurred to him that what could drive car wheels could drive grindstones. He put in a 2 H. P. T. H. motor, and now grinds razors, and all kinds of cutlery by electric power. He has the satisfaction of having reduced his working expenses by nearly one-half, and doubled his business by his enterprise.

In the office of the *Times*, which has been brought up mainly by the labors of its indefatigable editor, Col. H. G. Otis, to the position of the leading paper in Southern California, everything is run by electric motor power, except the big Hoe presses, and this utilization of the best available form of power is characteristic of the general policy of the paper in its recognition of modern needs and conditions. Col. Otis entered the *Times* in 1882, and it is now controlled by a company, with a capital stock of $240,000, and with Col. Otis as president and general manager. The plant presents one of the completest adaptations of electric power to be seen on the Pacific Coast. The 10 Linotype machines in the composing room are operated by a 6 H. P. Edison motor. A 9 H. P. Edison motor, of the same type takes care of the paper damper, the air compressor, which feeds the oil burners under the boilers for running the big presses, and a generator, which gives current for lighting the building. The same motor supplies the power for the stereotyping room. It is proposed to extend the facilities of this service by shortly superseding the 9 H. P. by a 15 H. P. Edison motor.

A peculiar reminder is found, in a private house in Los Angeles, of the fact that California is the desired haven of sufferers from pulmonary affections, in the shape of a 2



KNIFE GRINDING BY ELECTRICITY.

H. P. 500 volt Crocker-Wheeler motor generator. This was used for generating ozone. It was brought westward by the well known editor of a leading Chicago paper, whose wife was affected by pulmonary trouble. One of the painful accompaniments of the patient's malady was insomnia, and the inhalation of ozone never failed to bring

refreshing sleep. The motor was connected to an influence machine, and the production of ozone was proceeded with in the ordinary way.

Two tent and awning factories are worked electrically, each having a 1 H. P. Crocker-Wheeler motor for running the heavy machines for stitching tents, canvas awnings, &c. This work, which was formerly done by girls, was most arduous and exhausting. The 6 or 8 machines used in each factory now do effectively and easily the work of a small army of manual operators.

One of the novelties in motor work in Los Angeles is the grinding of rock for the making of aluminum paint. The rock is brought from a quarry near San Bernardino. A 5 H. P. T. H. motor works the crushing machines for the various grades of rock, as well as the mixers. The special utility of this paint in resisting weather has been recognized by the Government, and it is being used for painting the army posts and barracks throughout the Western country.

But the list of industries in Los Angeles in which the electric motor is employed is much too long to be exhausted here. It comprises, besides dental lathes, ice cream freezers, barber's shop fans, and the many applications which are now familiar in every city, the running of a boot blacking establishment, where the shoes of the customers are polished by rotary brushes; the making of a favorite brand of suspenders; the grinding of bones for the fertilization of orange trees; the manufacture of metal pipes, and the working of silk looms; an electrician runs an extensive electric repairing shop entirely by electric motor, and an astute baker uses the same agency for the mixing of his dough.

The motor business began in a small way in Los Angeles, but good service was maintained from the start by the power company, and it has grown with almost unprecedented rapidity. Much of the success of the undertaking is due to the personal efforts of the electrician of the company, Mr. L. B. Pemberton, to whom I am greatly indebted for his valuable assistance in collecting the foregoing data.

ORIENTING THE CRATER IN LANTERN PROJECTION.

BY

Fr. C. Van Dyck,

The report of Mr. E. P. Hopkins' lecture on "The Use of Electric Light in Lantern Projection," appearing in THE ELECTRICAL ENGINEER of Jan. 30, moves me to describe a device which I have recently perfected.

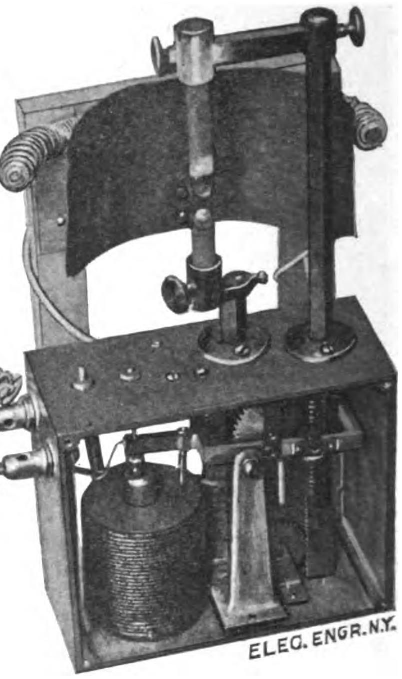
It depends upon the well known action of a magnetic field on the arc. The lamp used is the modified Ward lamp. The carbons are about ½-inch in diameter, and the positive is cored. Supported on the standard of the lamp is an electromagnet of semicircular form with a radius of about 3 inches, as shown in the accompanying engraving.

The core is ⅜" iron and the winding consists of 100 turns of No. 14 double cotton magnet wire.

A variable shunt is attached so that the field of the magnet is under control. The plane of the magnet is perpendicular to the carbons, and contains the arc. Between the carbons and the magnet there is a semi-cylindrical shield of sheet brass which keeps the magnet sufficiently cool.

With this arrangement there is a flaming arc and the crater remains steadily on one side. The crater is oval and its plane makes an angle of about fifty degrees with the axis of the carbon. The negative carbon is sloped and flattened so that the angle is about the same as that of the crater. The back edges of the slopes stand about an eighth of an inch apart with eleven amperes.

Tests with ammeter and voltmeter show that the current is slightly less and the voltage slightly more while the magnetic field is on. With less current the field makes larger variations. The carbons burn away considerably faster, but to what extent has not been noted. The regulation of the lamp is slightly less perfect than when running the usual way, but that of J. B. Colt & Co., described by Mr. Hopkins in the article above referred to



ORIENTING THE CRATER IN LANTERN PROJECTION.

would not suffer from the device, I believe. Just how much more light I get through microscopic lenses is hard to estimate, but certainly fifty per cent. The field on the screen is much more even, too, and would be perfect with sloping carbons. Let me recommend to all engaged in projection to try magnetic orientation, patiently adjusting with the certainty of final success.

THE ELECTRICAL STATISTICS OF BOSTON.

The condition of Boston electrically is set forth by Wire Commissioner John R. Murphy in his first report. It covers the electric plants of seven large companies, some small ones, and a few individuals. The total number of electric lights in use is 226,251; 219,658 of these are incandescent, and 6,598 are arc lamps. In the seven large companies the number of motors in use is 4,086.

The total electrical horse-power employed daily for electric lighting and power purposes is 27,889, requiring for its generation 38,799 mechanical horse-power.

The maximum capacity of eight power stations is 42,010 mechanical horse-power, capable of furnishing 30,660 electrical horse-power.

There are in the city 1,999,523 feet of underground duct, of which 740,911 feet are for electric light and power service, 1,252,076 feet for telephone and telegraph circuits, and 6,536 feet for signalling and miscellaneous purposes.

The number of feet of cable employed for telephone and telegraph purposes is 566,000, containing about 70,000,000 feet. The power and lighting cables are over 655,000 feet in length, and for miscellaneous service 1,222,620 feet of underground wire are employed. The number of feet of cable already in the ducts is 1,450,544.

There are over 5,000,000 feet of overhead wire in the city, but an era of underground work has just begun, as noted recently in these columns, and the present year will see a large quantity of underground cable put down.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE LAMB ELECTRIC CABLE WAY FOR CANAL BOAT HAULAGE.

In our issue of July 18, 1894, we described the experiments made with the Lamb electrical cableway for canal boat towing, at Trenton, N. J. Since that time experiments have been going forward actively to adapt the system to all the requirements of canal traffic. The results have demonstrated the system to be entirely feasible for canal boat towing, and the well known Trenton Iron Works, of Trenton, N. J., who are introducing the system, stand ready to guarantee its successful working.

The distinctive feature of Mr. Lamb's motor, it will be recalled, is, that unlike all others heretofore tried in telpherage systems, it is propelled by friction obtained independently of the weight of the apparatus. The motor can, in consequence, travel up the incline due to the sag in the cable net on approaching the brackets. Fig. 2 shows the motor, resting on the suspension cable, but does not show the cable by which the motor hauls itself and a boat along.

The recent test, as illustrated in the engraving Fig. 1, was made to demonstrate the ability of the machine to tow a boat around sharp reverse curves. The deflection of the cable at each bracket was 6 degrees, and the motor pulled the boat at full speed around the right and left curves with ease. By this test it is proven that the motor can pull a boat around the sharpest curves to be met on any canal, as the tangents can be made as short as desired by placing the brackets close together, and a deflection of 6 degrees be made at each bracket.

On canals where the traffic is light a single cable can be used, and when boats going in opposite directions meet, they can ex-exchange motors and proceed. This is done by exchanging hawsers. The low cost of the cableway makes but a light fixed charge for interest when two cableways are used. One of these cables would be erected on the inside of the tow path, and the other on the berm of the canal on the opposite side. The mule traffic can, in consequence, be continued while the electric motors are in use. The system requires no changes in the present methods, as the electric motor simply takes the place of the mules. Boats require no additional outfit and gain for freight the space which at present is used to stable the mules. In this particular this system has an advantage over all others, as the addditional earning capacity of a boat due to the extra room thus gained is a very considerable item during the course of a year.

In comparison with mule propelled boats, the Lamb system has the following advantages: a motor with one attendant can tow two or more boats at the same time, thus reducing expense of crew. It doubles the speed or can go as fast as is advisable for the maintenance of the canal banks, thus increasing the earning capacity of the boat. It lessens the outlay necessary to equip and maintain a canal boat by doing away with the mules. It is no uncommon thing for mules to be pulled into the canal and drowned by sudden gusts of wind blowing boats suddenly away from the tow path. The Lamb system also reduces the expense of propulsion, as it has been shown that in street car service the cost per car mile for horses is from 18 to 25 cents, and the cost per car mile in electrical trolley system is from 10 to 15 cents.

The relative advantage will be greatly increased in canal boat work as the speed of the mules in comparison with the motor is relatively less than the speed of the street car horses in comparison with the electric car. Again the street car uses two horses while the canal boat uses six, and the street car uses two motors of a larger size while the cableway uses one. The energy required for street cars is greater than is necessary for the cableway as the former has to get its tractional friction to propel it from a greater weight, while the cableway is light, and the boat is hauled along independently of its own weight. When a boat is once under way the service performed by the motor will be comparatively light, thus using only a fraction of the energy needed at the start.

It will therefore be seen that the comparison of the relative cost of the horse and trolley cars as given above can be expected

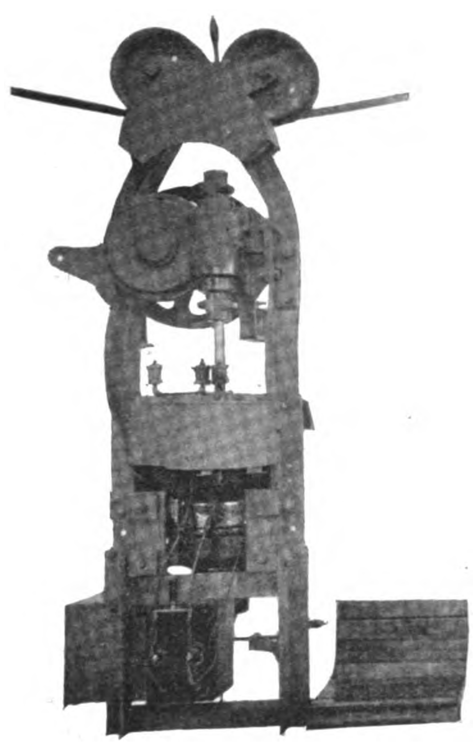


Fig. 2—. The Lamb Canal Boat Hauler.

to be bettered in the subtsitution of the electric cableway for mule propulsion. Ex-State Engineer John Bogart, in his report on the Erie canal, showed the fixed annual expense of a mule boat to be $2,166. Of this, $1,304 is attributable to the mules. The cost of an electric motor per season should not approach the cost of mules, as the proportion due to power for driving a boat during a season would be comparatively light. The economy in using the system is therefore obvious.

In comparison with steam propellers the wash of the banks from the action of the propeller has prevented a sufficiently reasonable speed being maintained for the economical use of

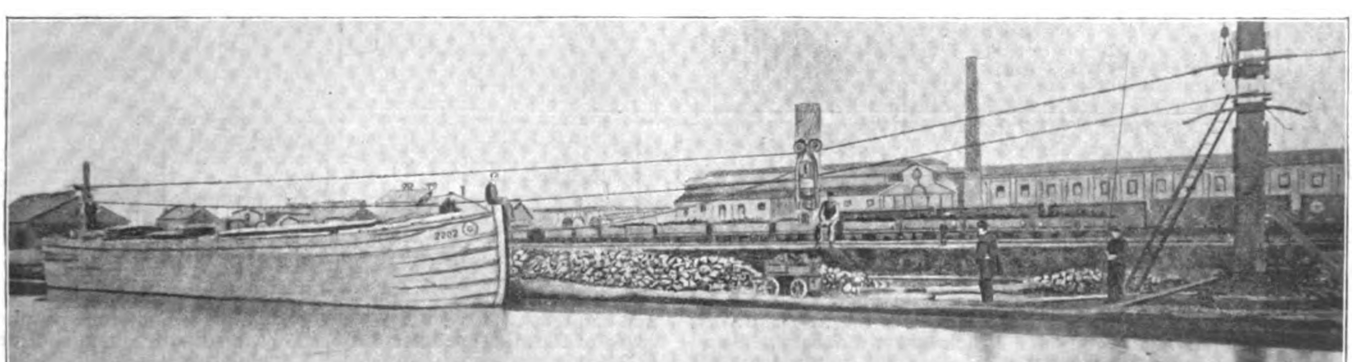


Fig. 1.—Lamb Electric Cable Way for Canal Boat Haulage at Trenton, N. J.

steam, as a greater amount of coal is burned for a given distance, because of the time consumed. It is estimated that an average of 86 tons of coal per round trip on the Erie canal is consumed, which at $4.25 per ton is $153. With only about 4 K.W. needed per boat the energy consumed per round trip would be insignificant compared with the consumption of coal, especially when water power is used to generate the electricity.

When a steamer or electrical propeller is laid up for repairs its motive power ceases to be useful for the time. In the case of the Lamb system the boat can be repaired while the motor it would have used is used to pull other boats. On the other hand, when the motor needs repairs the boat uses another motor as a number of them would be kept in the motor stations at both ends of the line, as is now done with mules on some canals. It is no small consideration in favor of electricity over steam that the danger of explosions of boilers is avoided, and licensed engineers are not required. The Lamb system would not lessen the value of the canal boats now using steam, as they would save money by using a motor in going through the canals where they are obliged to go slow, and would save their fuel for use in the open waterways where they could run faster and burn less coal per mile.

Mr. Lamb claims that in comparison with electrical propeller systems designed on the principle of the trolley all the disadvantages encountered in the recent State experiment on the Erie Canal are overcome by his system. These difficulties are, that the boat has to be steered so as to keep the trolley on the wire ; the difficulty of two boats going the same way and the rear one passing the front one ; on disconnecting the trolley, the boat loses its power and cannot proceed to get ahead of the boat in front of it. In the Lamb system they steer by each other and exchange motors and proceed.

But the great advantage claimed by Mr. Lamb is the large difference in the power required per boat. The cost of the motors in the trolley propeller system for a canal boat in many instances would more than equal the value of the boat into which they would be placed. With the Lamb system the most worthless boat hires its motor for the trip or goes in tow with others, requiring no extra equipment. The cost of a motor for the Lamb system would not be more than that of a first-class pair of mules, and the former needs no groom to keep it when not in use, and does not "eat its head off," as canal boat mules do in the winter time. The captain of the canal boat which was used during the test, said while elated with the success of the experiment: "Good bye mules. I hope now you won't have another chance to send my soul to ——, cussing you stubborn beasts into a decent gait."

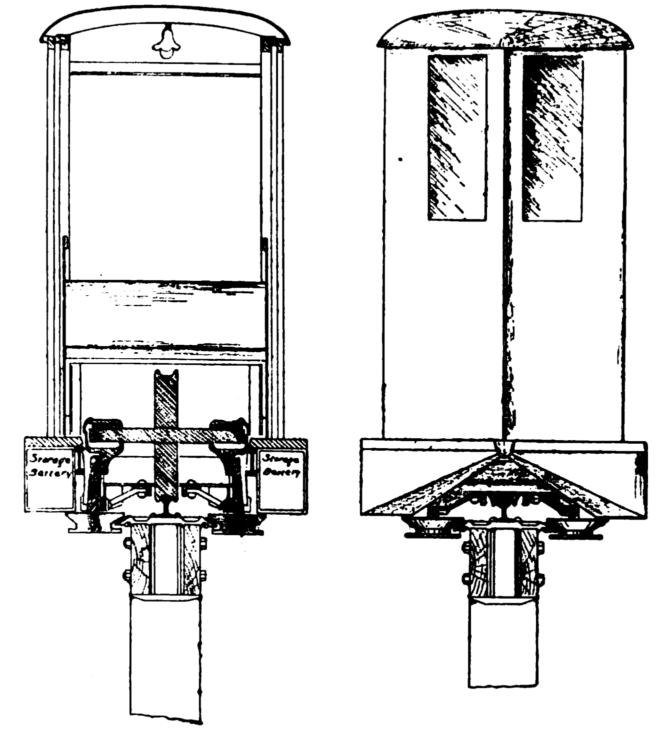
THE BEECHER SINGLE RAIL SYSTEM.

In THE ELECTRICAL ENGINEER of Jan. 16, we gave a view of the Beecher single railway recently put in operation near Waterport, N. Y., and are now enabled to add some additional details of construction of this novel road.

The plan upon which the system is based is shown in the accompanying engravings; Figs. 1 and 2 representing, respectively, a section and front elevation of the track and car, and Figs. 3 and 4 a side elevation and plan.

The track consists of two wooden stringers from six to fifteen feet above the ground, supported by posts every twenty feet; upon the stringers at intervals of three feet are bolted cast iron ties which support the centre T rail, and two guide rails, the latter being eighteen inches apart and the T rail between, four inches above them.

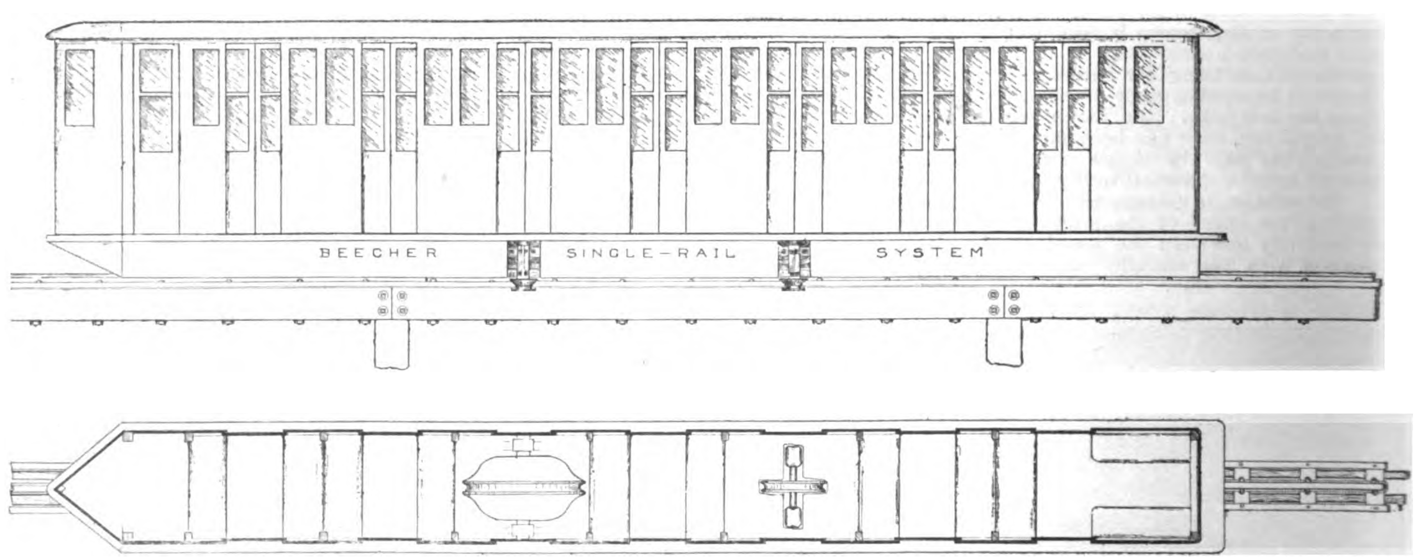
The car runs with two double flange wheels upon the T rail and has four beveled guide wheels, two on each side, which serve to keep the car erect. They bear upon the guide rails only when the car is not vertical. The guide wheels are provided with an under flange which makes derailment impossible without breaking the track or guide wheels. When under motion the car evinces the true bicycle tendency to run exactly upright and it is found that the guide wheels do not touch the guide rails except occasionally with a swinging motion from one side to the other.



FIGS. 1 AND 2.—THE BEECHER SINGLE RAIL CAR.

Experiments have been made on a track about seven hundred feet long of very poor construction. A car was equipped with a 5 H. P. motor, and fifty 200 ampere-hour cells of Chloride accumulator. It weighs complete without passengers about three tons and can seat twenty-four passengers. With twenty-four people a speed of 28 miles per hour has been obtained with an expenditure of 3¾ H. P.

While making trips during a snow storm it was found that a thin layer of snow only broken by the guide wheels at intervals of fifty to seventy-five feet remained on the guide rails after the



FIGS. 3 AND 4.—THE BEECHER SINGLE RAIL CAR.—SIDE ELEVATION AND PLAN.

car had passed, showing conclusively how little the guide wheels came into play, while the car was under motion.

A line of track four miles in length, using this system is being built between Waterport and Lakeside Park by the Equipment Construction Company at Waterport, the equipments for which will consist of motor cars to draw two trailer cars each. Each motor car will carry about four tons of storage battery, and will be operated by a 30 H. P. Johnson concentric motor, with a 40 inch driving wheel. They will maintain a constant speed of sixty miles an hour for five hours, covering a distance of three hundred miles on one charge of the battery. The battery is not removed from the car for charging, as with its large capacity, charging can be done at night.

The car is divided into compartments four feet long each containing seats for four persons. Each compartment is furnished with an electric light, and heater. All the cars will be fitted with powerful magnetic brakes of special design which will be under the control of the motorman, and the guide wheel journals have ball bearings. It is also intended to experiment with roller bearings for the main wheels.

Captain Lina Beecher, of Batavia, the inventor of the system, and vice president of the Equipment Construction Company, has been at work developing it for some time and has brought it to a high degree of perfection, for light cross-country railroads, and high speed travel. Mr. M. H. Johnson, of Utica, secretary and treasurer of the Equipment Construction Company, designed and installed the equipment for the experimental car which has been in operation, and has charge of the designing of the new equipments upon which his concentric motor will be used.

An experimental car is being designed to test the possibilities of the system for high speed work, with which it is expected to attain a speed of 150 miles an hour. The safe limit of speed appears only to be governed by the strength of the material used in the construction of the track and rolling stock, as cars cannot be derailed without breaking track or wheels.

Among the many advantages of this system, that of being out of the snow in winter has been fairly demonstrated during the late storms. Right-of-way for roads using this system is easily obtained, as the passage of the line over land results in little damage to property and does not interfere with its cultivation. The track and rolling stock are cheap and operating expenses small. A great future for the system is confidently predicted by engineers who have looked into its merits.

UNDERGROUNDING THE WEST END RAILWAY FEEDERS.

The West End Railway Co., of Boston, has lately been doing a large amount of work in placing underground its lines of feeders from the Albany street power house. Our illustration shows part of the work in process. The cable used is that of the Norwich Insulated Wire Co., who have furnished no less than 20 miles of

DRAWING NORWICH CABLE INTO NATIONAL CONDUIT SUBWAYS, BOSTON, TO BE USED AS WEST END FEEDERS.

their paper insulation, lead-covered cable. It has been drawn into the well-known subways of the National Conduit Mfg Co., who have laid down an excellent network of their cement lined pipe. There are in all 22 of the Norwich cables, and of these 9 are each about 1¼ miles long. The cables carry 500 amperes at 500 volts, but have, it is said, run much above this when called on. As each cable was finished it was immediately put into operation; and the corresponding ærial line was taken down and put in an adjacent duct as part of the return circuit. The "return" is now so abundantly coppered, that the possibility of electrolytic action is, it is said reduced to a minimum. The cables are all grounded on both sides of the manhole with a flat No. 6 conductor. The laying and drawing in of the cable was carried out under the supervision of Mr. E. W. Stevenson, E. E., of the Norwich Co. His gang of 8 men handled about 4,000 feet easily each day. One jointer was enough; in fact, the simplicity and ease of jointing was such, that the jointer, who was a clever hand, succeeded some days in getting in 15 or 16 perfect joints in a day.

The circuits of the West End Railway Co. are much improved by this work, in appearance, and it is believed that the material gain will be considerable.

THE ELECTRIC STORAGE BATTERY COMPANY'S PLANT FOR LIGHT AND RAILWAY AT MERRILL, WIS.

Merrill, with a population of about nine thousand, is situated three hundred and fifty-two miles northwest of Chicago, in the lumber regions of Wisconsin, on the Wisconsin River. The city is divided into the east and the west side by the Prairie River, which here flows into the Wisconsin. The Merrill Light and Railway Company furnishes all electric light in the city and operates the electric railway, connecting the two parts of the town.

The electric lighting of the city is divided between two stations, that on the east side being run from a water power plant, and the west side from a steam-power plant. The railway generator is

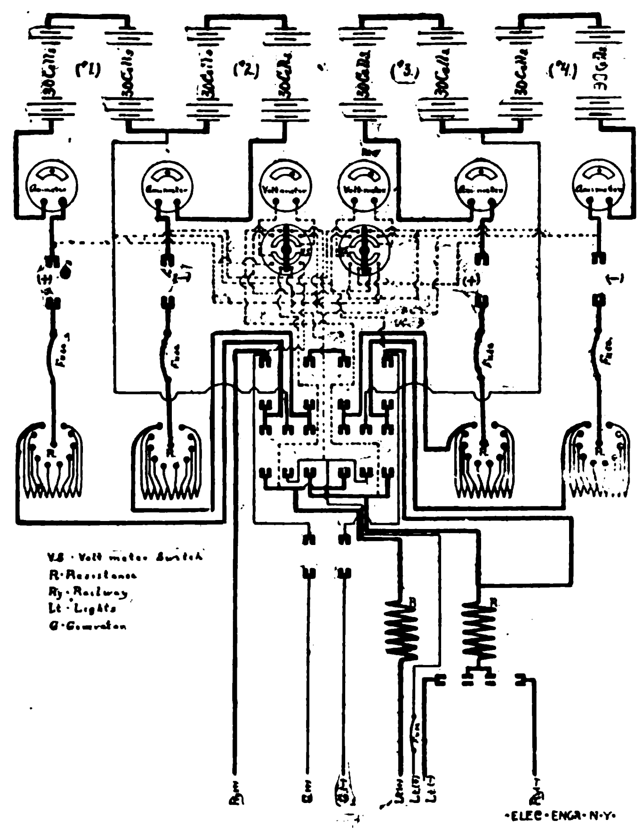


FIG. 1.

operated by a water wheel at the east side station. The latter plant contains two water wheels, one for lighting, the other for railway, which operate two 25 K.W. Edison machines, run on the three-wire system; one United States machine of 25 amperes and 500 volts for series incandescent street lighting, and a Westinghouse railway generator of about 75 K. W. capacity. The west side electrical equipment comprises a 20 K.W. Edison, a United States machine of 25 amperes and 500 volts, and a 30-light T.-H. arc dynamo. The railway is one and three-quarters miles long, single track, with two turnouts. The road was built for three cars, but ordinarily only two are operated, with from ten to fifteen minutes headway.

Some months ago the company was brought face to face with that problem, so frequently occurring in the electrical field, of the best plan for enlarging the power plant to meet the requirements of increasing demand, and it was decided to install a storage battery plant in a sub-station, at or near the distant light centre, the

power-house being itself at one centre. It was also decided that the battery should not only be utilized for increasing the light capacity, but also for regulating the voltage on the railway circuit, which was far from satisfactory, owing to the impossibility of obtaining a governor for the water wheel, which would respond to the great fluctuations in railway demand. In fact, it had been determined that better results were obtained by running the wheel entirely without governor. The curves shown in Fig. 2 indicate the results obtained from such operation. It was during the hours of heavy lighting, however, that the unsatisfactory operation was most manifest, when it became necessary to couple to the same shaft, the wheel driving the lighting machines and that running the railway generator, in order to obtain sufficient power for lighting. So limited was the power, that only one car could be run during lighting hours, and even that in a feeble, uncertain way. The curves in Fig. 4 were taken during such a period. It will be noted that every fluctuation in railway demand causes a corresponding fluctuation in lighting circuit. A frequent fluctuation of as high as nine volts, on each side three-wire system, was recorded.

The storage battery plant, recently installed, is situated midway between the east and west sides, on the line of the trolley road, about three-quarters of a mile from the east side power-

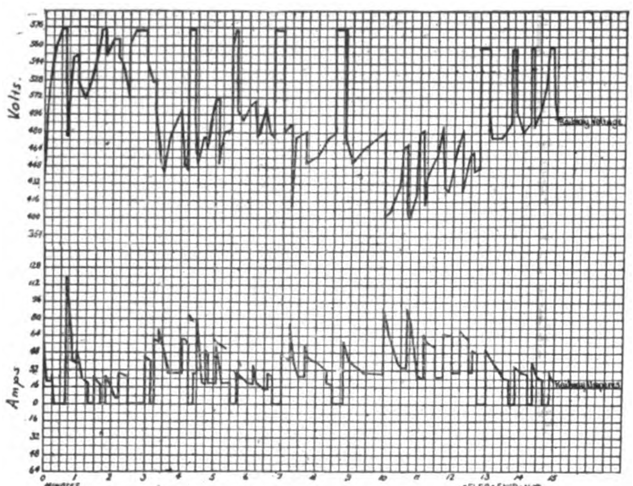


FIG. 2.

house, and one-quarter of a mile from centre of west side light distribution. The plant contains two hundred and forty 11 "F" Chloride accumulators, capacity 500 ampere hours at 50 ampere rate, manufactured by The Electric Storage Battery Co. of Philadelphia. These are divided into four series of 60 cells each, connected to a switchboard, so arranged that cells may be connected to the railway, 240 in series, or to lighting circuits, two parallel series of 60 cells each, on each side of three-wire system,

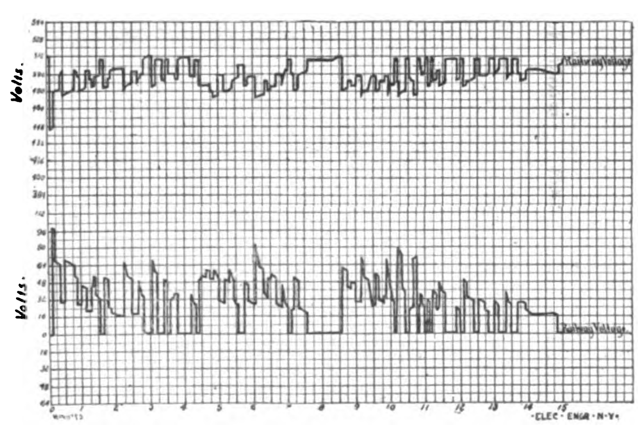


FIG. 3.

capable of supplying, normally, four hundred 16 candle power lamps for 10 hours, or, at maximum discharge, 600 lamps. An independent feeder connects the battery with the east side power-house, three-quarters of a mile distant. A variable resistance is put in circuit between battery and railway, so that when the battery is fully charged, requiring a voltage of 600, the voltage on the railway may be cut down if necessary.

A diagram of the switchboard connections, is shown in Fig. 1. The position of the blades in the two large double-throw three-point switches, in the centre of the board, determines the connec-

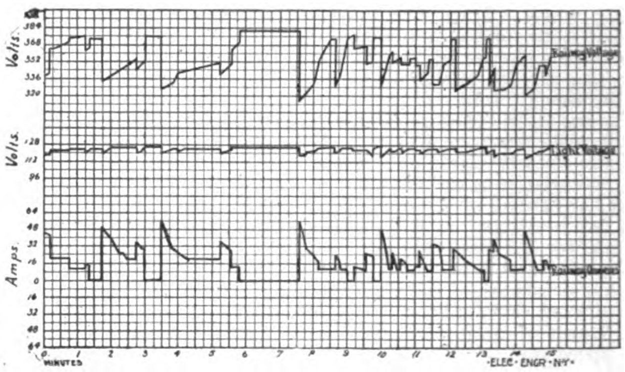


FIG. 4.

tion of the battery, either to the railway circuit with 240 cells in series, or to the three-wire lighting circuit, with two parallel series of 120 cells each, when in the reverse position. Small rheostats on the switchboard are used for equalizing the four series, when discharging on the lighting circuit. Two large rheostats are placed in the lighting circuit, one on each side of the three-wire system, to regulate the battery discharge on the line. By means of a double throw, single blade knife switch, Fig. 3, under the right hand discharging rheostat one of these rheostats can be cut into the railway circuit and utilized for regulating the battery discharge. By reference to the diagram it will be seen that the feeder from the power house generator is so connected to the board, that the generator may be disconnected from the railway circuit without disturbing the battery connection, and *vice versa*. Thus, if the generator fuse blows, the battery will run the railway

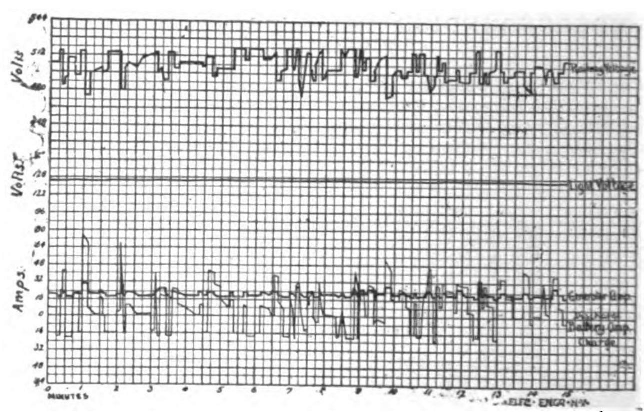


FIG. 5.

without interruption; if for any cause the battery is disconnected, the generator will perform the work on the railway. When discharging all in series the four ammeters read together; when in two parallel series, each ammeter gives the discharge of the 60 cell series to which it is connected. The ammeters read both ways, indicating both charging and discharging current. The right-hand voltmeter (by means of a four-point voltmeter switch) gives the voltage of each of the four sixty-cell series, while the left-hand voltmeter gives the voltage of the two hundred and forty cells in series, of the railway circuit, and of each side of the three-wire system.

A switchboard at the power-house, containing voltmeter, ammeter, fuses, switches, field rheostat, and automatic break, enables the dynamo tender to connect the generator to the railway direct, or to the battery feeder, and to regulate the current without any assistance at the battery-house. He can also determine, by reference to the voltmeter, the condition of battery charge, and regulate the charging current to the best advantage. It is, therefore, unnecessary to have an attendant at the battery-house, except when a change is made in battery connection from railway to lighting circuit, and *vice versa*, and when the requirements of service demand more or less resistance in circuit.

The charging is performed altogether by the railway genera-

tor, during the period when cars are running and the battery is not required for lighting, the battery at the same time regulating the railway voltage and the demand on the generator. The curves shown in Fig. 5, record the operation of the generator and battery, when the generator was delivering an average of 20 amperes and the battery was charging or discharging according to requirements. The battery curve when above the 0 line indicates discharge and when below, charge. The sum of generator current and battery discharge gives the total current used on the railway. At an average generator delivery of 30 amperes on a clear day, with two cars running on a clean track, the battery charge remained practically constant, neither increasing nor diminishing, indicating that 30 amperes is the average current required for running two cars. As fifteen minutes is the maximum time consumed in making a trip, the record of a day's run is practically a succession of curves as shown.

On January 4th, 1895, the battery was connected to the railway circuit. The great improvement in the running of cars was immediately noted by all, but it was at night that the contrast was most apparent. The two water wheels were connected together as usual, but the railway generator charged the battery at almost a steady rate, instead of running a car with its ever-varying demand of from 0 to 120 amperes. Instead of one dimly-lighted, slow-running car, two brilliantly-lighted cars were operating at the highest speed allowable on the streets. Instead of a succession of sharp peaks, the voltage curve of the lighting circuit became practically a straight line; instead of nine volts variation on each side of three-wire system, as at first, there was practically no variation, demonstrating most clearly the capability of the battery to respond to all demands of the railway, no matter how severe. The contrast is shown in Fig. 4 and Fig. 5, the "before" and "after" in the operation of this plant. On several occasions, the two cars were operated by the battery alone for several hours at a stretch, thus in the daytime admitting of the entire shutting down of the power plant and at night of the use of the two water wheels exclusively for lighting. The curves in Fig. 3, show the result.

The company intends to increase its power at the east side plant by the addition of a water wheel to operate the railway generator. By this addition the two wheels now in use may be utilized for east side lighting, while the battery carries the west side incandescent lighting. The battery will be charged during the day, as at present, from the railway generator, at the same time keeping the voltage even on the trolley circuit. This plan will enable the company to do away entirely with the west side steam plant, there being surplus water power sufficient to run the arc and 500-volt incandescent machines now at the west side.

This installation demonstrates the great value of storage battery installation, in connection with light and railway plants; First, as a reservoir, in which to store up energy otherwise lost—the difference between the average demand and maximum demand on a generating plant; second, as a regulator of pressure on circuits subject to fluctuating demands, not only adding to efficiency of service, but also reducing the wear and tear on apparatus producing current and operated by it; third, as a transformer, utilizing high voltage charging and discharging at any lower voltage desired.

IMPROVEMENTS IN BROOKLYN'S TROLLEY LINES.

Peter T. Austen, John Gibb, Ditmas Jewell, William H. Nichols, and R. S. Walker, who were appointed recently by Mayor Schieren of Brooklyn as a special Advisory Commission to investigate the trolley system and devise some plan for operating the cars more safely, have submitted a report embodying the following recommendations:—

1. The speed of trolley cars should not exceed ten miles an hour.

2. Every car should be provided with a device giving an audible signal when the speed of the car exceeds ten miles an hour.

3. Passengers should not be allowed to ride on the front platforms, and both gates of the front platforms should be kept closed when the cars are in motion.

4. The gates on the track side of the rear platforms should be kept closed.

5. Cars on all lines crossing main thoroughfares on which there are car tracks should come to a full stop before crossing. Cars on main thoroughfares must be kept under perfect control and run at a reduced speed at such crossings.

6. All cars should be provided with reliable fenders, which should be approved by a commission of experts.

7. In case of an accident occurring through the negligence of a motorman, the motorman should be held criminally responsible therefor.

8. It being the opinion of this committee that accidents have occurred which have been due to the use of intoxicants by employees, we earnestly recommend that the companies provide at their respective depots comfortable waiting rooms for the men, where tea and coffee may be obtained at reasonable cost.

9. The tracks shall be kept sufficiently sanded where needed.

10. As cars are often wilfully and unnecessarily obstructed by traffic wagons, we advise that the law that makes it a misdemeanor wilfully to obstruct, hinder, or delay the passage of any car running on a street railway be rigidly enforced.

11. We consider that the present overcrowding of the cars is indecent and a frightful source of inconvenience, delay, and danger, and we therefore strongly recommend that the number of passengers carried on any car should not exceed its seating capacity by more than 50 per cent. We are aware that the enforcement of this rule will necessitate an encrease in the number of cars, but we consider that the public is entitled to proper and decent accommodation.

PARALLEL STEAM AND ELECTRIC RAILWAYS.

Mr. Henry C. Robinson, counsel for the New York, New Haven and Hartford Railroad Company, has announced that the managers of the road feel called upon in the interest of their stockholders to oppose all electric railroads which will parallel the Consolidated or its branches. Vice President Hall is at present engaged in preparing figures showing how the competition of existing electric railroads parallel to the Consolidated have affected the receipts of the steam road and necessitated the taking off of several trains. A map is also being prepared showing the paralleling street railroads everywhere in Connecticut from the New York line to Springfield.

A RUMORED STREET RAILWAY CONSOLIDATION.

There is a report that the Broadway Cable Company of New York city, the Consolidated Traction Company of New Jersey, which includes every street railroad in Essex, Hudson and Union Counties, except one, and the Philadelphia Traction Company are to be consolidated. This would make one of the largest corporations in the United States. The amount of stock represented in the roads of the three cities of New York, Philadelphia and Newark, is estimated at about $200,000,000.

Some foundation seems to be given to the rumor by the fact that the largest stockholders in the Consolidated Traction Company of this city are the largest stockholders in the Broadway Cable Company and in the Philadelphia Traction Company as well.

ELECTRIC ROAD BETWEEN NIAGARA FALLS AND BUFFALO

Everybody in Niagara Falls is rejoicing, says the *Buffalo Express*, over the letting of the contract for the building of the electric road between the Falls and Buffalo. The contract, as W. Caryl Ely announced, was formally signed recently in Buffalo, and it was mainly through Mr. Ely's tireless efforts that this road was secured. According to plans, the road is to be built of 94-pound steel girder rails, with side trolley poles. It is to be double-tracked except for a distance of 2½ miles, where the highway commissioners of the town of Wheatfield refused to grant more than a single-track line franchise. The best feature of all is that it will give Buffalo and Niagara Falls cheap fares, the rate to be but 50 cents for the round trip at all times. Quick time is to be made, and in order to do this the road is to be made so that heavy cars can be used. The running of late cars will keep hundreds of Buffalo people in Niagara Falls until late in the evening, who now are obliged to go home before the really enjoyable part of the day about the Falls comes. The power for operating the road will be furnished by the Niagara Falls Power Company, and according to the contract, the cars will be running by July 1st of this year. In Niagara Falls the road will be run on the tracks of the local street-railway company from Echota, and this line, which is now a single track, will be double-tracked this spring and rebuilt entirely.

All the capital for the building of this road has been secured, and the moment the weather permits, work on its construction will begin. The first section between Buffalo and Tonawanda will, it is said, cost about $500,000, complete.

LEGAL NOTES.

THE TELEPHONE RATE BILL.

The Telephone Rate Bill, before the Senate Cities Committee of New York State, has been amended so as to raise the rate in New York City from $78 to $125 per year, in Brooklyn from $66 to $85, and in cities of from 100,000 to 500,000 population it was left at $48. Subscribers are to be allowed fifty messages free to their own telephones from any pay station. Any company not making ten per cent. on its investment may appeal to the Commission provided in the bill for an investigation and an increase. Provision is made for either the toll or flat-rate system. Expenses of investigation are to be borne by the telephone companies, but are not to exceed $10,000. Subscribers may complain of rates, and if the complaint is upheld, the company is to pay expenses; if not, the subscribers must pay them.

The committee has adjourned until March 19 for a final hearing.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Vol. XIX. NEW YORK, MARCH 13, 1895. No. 358.

CONTENTS.

LOCOMOTIVE BUILDING.

We should not be at all surprised to see some of the locomotive building companies engage in the manufacture of electric rolling stock of one kind or another. The statistics of steam locomotive building last year are not only disheartening, but they appear to lack the elements of large recuperation. Last year ten principal companies built 695 locomotives; three built none. In 1890, some 15 companies built 2,300, a number that would seem to touch high water mark. It is also noteworthy that last year 15 important car companies did not build any rolling stock, although in 1893 they had turned out some 3,000 freight cars and 300 passenger cars. Last year only 27 car companies did work worth mentioning.

Everybody is aware that the country has been passing through a period of terrible depression, and that the steam railroads have felt the pinch of the bad times more acutely than wellnigh every other industry. Hence it need not be surprising that no one company built half as many locomotives as it did the year before. But the question arises whether the lost ground can be reconquered, whether some of this loss is not due to the growing resort to electricity, and whether in a few years the output of electric locomotives will not be as large as that of steam locomotives—even larger, possibly. After so long a period of suspended purchases, it is open to doubt whether when they begin to buy again freely, the railroad companies will not resort largely to electric power.

It may be noted that during 1894, the number of electric cars in this country increased from 17,128 to 22,849, plying over 9,000 miles of track. Granting that part of this increase was at the expense, or to the benefit, of the horse, it is remarkable that so high a rate of growth should be maintained. Electric cars are now more than half the total number in use of all classes, and their mileage of track is about 75 per cent. of the whole. In other words, the victory in the street railway field is complete, within seven years, and it would be far more sweeping had the times been better, allowing improvements in equipment to be made. The electric railway industry is now at that point where it is entering upon the mastery of the shorter steam roads. By shorter, we mean any of 40 or 50 miles length from end to end. Obviously this work cannot go forward very far without curtailing the opportunities offered to the locomotive ; and if we were to enumerate all the plans for transforming old steam roads or building new electric ones across country, our readers might be forgiven if they jumped to the conclusion that the revolution had already been effected. But it may be doubted whether the impending change can have its full force until the revival of confidence and speculation permits the freer expenditure of money. Whether we shall then see locomotors or individual motor cars is a moot point. If the 5,721 new electric cars last year were in the ratio of one motor car in three, that would make nearly 2,000 new motor cars ; but the tendency in the new cross country work is in the direction of composite electric units at frequent intervals. Another feature of the new work is that these lines dispense practically with depots and time tables ; some of them running right into the city square, in among the local cars, and picking up passengers in the same handy, casual way. This modification may have some influence on the use of electric locomotives, should they follow traditional lines as so many of them have done up to date.

AFTER THE BATE.

Undoubtedly the probable effects of the decision in the Bate case, delivered by the Supreme Court, March 4, had been pretty thoroughly discounted by all parties interested. It is not very likely that any considerable number of them expected a different result. The stocks of the General Electric Company and the American Bell Telephone Company, the companies chiefly affected adversely, exhibited no immediate noticeable decline. Immediately following the decision, reductions in the price of incandescent lamps were announced by one or two manufacturers, and it was currently reported that the General Electric Company would make a sweeping reduction and put the price of 16 c. p. lamps at a figure so low as to keep out the competition of smaller factories. Quality and price must, evidently, be their reliance henceforth for the lamp trade.

Concerning the ultimate effect of the Bate decision upon both the General Electric Company and the Bell Telephone Company, it is to be noted that the Edison lamp patent, if good for the whole term, would have but two years of life before it; whereas the very important, if not fundamental, Edison carbon telephone patents would, because of the many years during which the applications were held up in the Patent Office, have some fourteen years to run, had they not been invalidated. The Berliner case having gone against the Bell Company in the Circuit Court, that company no longer possesses the monopoly of variable contact transmitters. Both the General Electric and the Bell Telephone companies have contract obligations with their sub-companies, or licensee companies, under which the benefits accruing to the parent companies are in consideration of exclusive rights and privileges granted to the licensee companies. As it will no longer be in the power of the General Electric and the Bell companies to maintain such rights and privileges in behalf of their licensees, so far as they rest upon the patents now abrogated, it seems not unlikely that some readjustments will be sought in the mutual contract obligations of the parent companies and the licensee companies. Inasmuch as the royalty charges of the Bell Company are but a small fraction of the charge to subscribers in the larger telephone exchanges, any modification of them would not materially reduce charges to the public, while it might make a considerable difference in the earnings of licensee companies. Questions of a similar character may well arise between the General Electric Company and the old Edison licensee companies, in respect to mutual obligations. It must be said, however, that the Edison licensee companies have had but scant protection in the exclusive rights under the Edison lamp patent and other patents of the General Electric Company. Although several injunctions against lamp makers have been obtained within the last few years, hardly any substantial benefit has accrued either to the General Electric Company or to its licensee companies therefrom.

THE VERSATILE MOTOR.

Now that the long nights are giving way to longer days, and the central station manager casts about for new ways of keeping up his load line at a high average, the electric motor demands and receives more attention. There is no doubt that electric power utilization is rapidly developing, but it seems to us that the growth is not half fast enough, in view of the great adaptability and high efficiency of the modern motor. We would like to know how many central station managers have made a complete power canvass of the territory covered by their circuits, and can tell by actual count the number of small steam and gas engines, or water motors, that they have a chance of displacing. This is but one way of getting at the possibilities; another is to encourage people who derive their power from long lines of shafting and belts run from floor to floor, to put in separate motors for themselves. We have heard it stated as an argument that it did not pay to do this, because one could go into an old style power building, and get all the power one wanted by means of the single payment for rent. This is fallacious. Nobody can supply power gratuitously. It costs something to make, and if it is not paid for directly, then it is in the rent somewhere. Moreover, the use of an electric motor will often enable a trade or industry to be carried on in neighborhoods or in blocks from which the employment of other power would exclude it. Instances of this kind are already common in some of our larger cities, and all that is needed is persistent preaching of electric power by those who have current to sell.

In our columns this week many examples are presented of the versatility of the motor. Mr. G. H. Guy, who has recently acted as our special correspondent in a trip over the Pacific Slope, furnishes a graphic account of miscellaneous motor work done on a special power circuit by the Los Angeles electric railway company. He mentions a number of interesting details. Then we have further novel applications in the Lamb canal boat haulage at Trenton, N. J., and the Beecher single rail light railway at Waterport, N. Y. There is abundant suggestion in all this, and as spring opens, we trust that the motor manufacturers will find not only a brisker demand than ever for fan and ventilating motors but for apparatus in a variety of fields they have not hitherto touched. But they must have the coöperation of the central stations, which, after all, are the chief beneficiaries of this great modern development of industrial electricity.

GOVERNMENTAL POSTAL TELEGRAPH DEFICITS.

According to a dispatch from London the figures of the government telegraphs of Great Britain reveal a bigger deficit than ever. The actual deficiency of the previous year, is put at $2,400,000, which includes $1,500,000 annual interest charges for the old purchase of private lines. The deficit for the year to March 31, 1895, is estimated at no less a sum that $2,700,000. The expected increase in gross receipts has failed to put in an appearance, the bad times having probably kept down earnings just as they have done here. But the weakness of a government system comes out at such periods, a weakness altogether irrespective of the care and ability with which it may be managed. In this country, the Western Union Co. earned and paid its dividends last year, and we understand that its current quarter will pay the regular dividend and show even a slight improvement in gross. The reason of this is that the private company has been able to put in practice economies that a government service cannot well attempt. The company can lop off an office here, another there; it can weed out poor talent; it can stint on construction; it can do what it chooses. A government service has a huge staff on civil service basis, to draw salary or pensions whether the business comes in or not; and every time it tries to curtail a service or stop extensions it is swooped down upon by angry parliamentarians or hungry contractors who want all that is nominated in their bond. In other words, there is for the private company all the advantage that flexibility has over rigidity; or that selfish economy of your own money has over the careless expenditure of somebody else's. The phenomena of deficit on governmental work in Europe are beginning to threaten a worse state of debt and disaster than all the wars she ever endured.

MISCELLANEOUS.

NOTES ON RECENT ELECTRICAL ENGINEERING DEVELOPMENTS IN FRANCE AND ENGLAND.—II.

(Concluded.)

BY H. WARD LEONARD.

Importance of the Load Factor in Central Stations.—All central station people have known for years that the most profitable consumers were those who used their lamps for the greatest number of hours.

In other words, that the net profit due to a consumer was largely dependent upon the relation between his average load and his maximum load, which Mr. Crompton in England has aptly called the "load factor." Yet, while appreciating this fact, central station companies make their rates dependent upon the kilowatt hours used, and independent of the maximum kilowatts used.

Mr. Arthur Wright at Brighton in England, deserves the credit, as far as I know, for having first given commercial recognition to this load factor of the consumer. Mr. Wright supplies each consumer not only with a meter which registers the kilowatt hours used, but also a second meter of simple construction which registers the maximum kilowatts used at any time during the month, and the discount which the consumer gets is very largely due to the relation between his average and his maximum kilowatts.

Suppose that there are two customers connected to a central station and that the monthly readings show that each has used 900 kilowatt hours. By the usual practice in this country the bill would be the same, yet one bill may be due to the use of one and one-quarter kilowatts for 24 hours per day, and for 30 days per month, and the second bill may be due to the use of 30 kilowatts, an average of one hour per day for 30 days per month. That is, the first bill may be due to a steady load, such as a few lamps in a basement of a hotel or a ventilating fan, while the second bill may be due to a larger load of lamps used only occasionally, as in an office building or an electric elevator requiring 30 K. W. for a few seconds to start it up, and after starting requiring only 15 K.W.

With the same 900 K.W. hours per month for the two cases, the central station company should charge at least five times as much for the case having the elevator and small load factor, as in the other case.

It is a fact not generally appreciated that in any central station the cost of producing a kilowatt hour can be divided into two portions, one of which, such as interest on cost, depreciation, salaries, a small part of the labor and coal, vary with the kilowatt capacity of the plant, that is, proportionately to the maximum load, and are independent of the number of kilowatt hours produced, and the other portion of the cost of producing 1 K.W. hour represented by the larger portion of the coal, labor, water, etc., is dependent upon the number of kilowatt hours produced, and is independent of the maximum load.

The fact about this matter which is least appreciated is, that the portion of the total cost of 1 K.W. hour produced, which depends upon the maximum load, is about two-thirds of the total cost, and the part dependent upon the output is only about one-third.

In a modern central station 1 K. W. of its capacity represents about $300 invested. Consider the two consumers cited above. Both loads are in use at the time of maximum daily load. For the elevator, the central station has to provide an investment of $9,000, for the ventilator fan $375. Assuming interest, depreciation and similar charges, and at 10 per cent. we have $900 to deduct from our gross earnings in the elevator case, before we reach net profits, and $37.50 in the other case. Suppose we get 10 cents per kilowatt hour in each case, and that the cost of production independent of general expenses, interest, depreciation, etc., is 50 per cent. of the gross receipts, etc.

This would mean that if we get 10 cents for each kilowatt hour in both cases, our gross revenue would be $90 per month in each case, and our gross profit $45.00 per month, or $540 per year in each case. But in the elevator case we have interest and depreciation charges of $900 a year, and hence have actually lost considerable money in supplying this customer, while in the other case we have made a net profit of over $500 per annum. We would have to charge more than ten times the rate per kilowatt hour to the elevator, that we charge to the ventilating fan to make the same net profit on $1.00 of capital invested. This load factor is a most vital question, and it is the difference in load factors in English and American central stations which makes storage batteries commercially possible there, and impossible here.

The average load factor of an English central station is less than 15 per cent., and even in London in December it is only 33 per cent., while in most American cities the load factor which averages in December 40 per cent., will in many cases be above 50 per cent.

This difference is due almost wholly to our motor load, which is an almost unknown quantity abroad. With a 15 per cent. load factor a storage battery may pay, but not with a load factor of 40 per cent., especially when the load factor in our central stations is rising each year.

If central station companies would offer such a discount due to load factor as to warrant the individual customer in installing at his own expense a storage plant which he would charge at the minimum rate per kilowatt hour by a steady current for twenty-four hours per day, and then use this stored energy to supply his occasional demands for an occasionally very large rate of energy, I believe it is possible that the central station companies, the storage battery companies and the consumers might all derive a profit from the arrangement. I have no doubt that a central station company could afford to make a rate of four cents per kilowatt hour for a continuous service night and day, and make a satisfactory profit, while it would surely lose money in supplying an elevator, such as described above, even at fifteen cents per kilowatt hour.

I believe that the following schedule of rates fairly represents the charges per kilowatt hour that should be made to customers of various load factors.

Load Factor.	Rate per K.W. hour in cents.	Resultant gross income per annum per K.W. of plant.
5	30	$131.40
10	20	175.20
15	16	210.24
20	13	227.76
25	11.2	245.28
30	10	262.80
35	9.2	281.07
40	8.5	297.84
50	7	306.60
60	6	315.36
70	5.3	325.00
80	4.8	336.38
90	4.4	346.89
100	4	350.40

It must be noticed that this argument would lose most of its force if the maximum load of the consumer did not occur at the time of day when the maximum load was upon the central station; but in elevators, and similar loads which call for their maximum load in starting up every few seconds, their maximum loads will not only occur together occasionally, but this will sometimes occur at the time of maximum load on the central station, and when this accumulated load is put upon the central station, the kilowatts must be there to meet the demand.

Electric Heating.—I saw evidences of a very healthy demand for electrically heated devices while abroad. In London the principal central station company is running at its own expense a show room for the education of the public in this line, and several manufacturers of electric heaters told me the demand was very satisfactory, and promised a good future.

The Heilmann Locomotive.—In France I examined what I considered the most important electrical engineering development of all that I saw. It was the Heilmann electric locomotive. Having been for some years past a firm believer in the merit of this machine, and having been in correspondence with Mr. Brown, Mr. Heilmann's electrical engineer, as to an invention of mine used in this locomotive for the first time on a large scale, I was especially interested in it, and my hearers will please discount as they may think necessary my description of the advantages of a locomotive using my system of control.

The locomotive I saw was the first one built, and was not in service when I was there. It had run 2,200 miles commercially, however, and as a result of the performance of this first locomotive which was 600 H. P., they are now building two locomotives of 1,500 H. P. each, which it is expected will go into commercial service about June next. This electric locomotive carries its own central station with it. It is really a complete central station on wheels, with its power used for propelling itself.[1]

The entire weight of the locomotive is 114 long tons; that is, about 15,500 pounds per driving wheel, which is about the same as our standard practice in this country. With a tractive coefficient of .2 this means a draw-bar pull of 50,000 pounds and assuming friction at six pounds per ton, we find that 50,000 lbs. draw-bar pull would enable us to pull 1,900 tons on a one per cent. grade at a low speed, say 15 miles per hour, and would give us ample draw-bar pull for handling a 200-ton train at any speed thus far seriously discussed.

Most engineers who have heard of the Heilmann locomotive have derisively dismissed it from their minds as a ridiculous monstrosity of a crazy Frenchman, but I have for some time believed, and am now convinced, that you will in the immediate future be bound to give this machine the most respectful consideration.

Under the electrical arrangement on this locomotive, the elec-

1. For a description of the Heilmann electric locomotive see THE ELECTRICAL ENGINEER, May 17, 1893, and March 21, 1894.

tric energy is used in such a manner that its voltage is varied in proportion to the speed desired, and the amperes are in proportion to the torque required, so that the electrical energy produced is utilized in the most efficient manner possible.

An electric locomotive of this kind would probably cost for the first few about $30,000, each being equipped with a 1,500-horse-power boiler of our best marine type, and one of our best automatic cut-off compound engines directly coupled to a modern multipolar generator. I believe that a locomotive of this type could be built which would be able to pull 50 per cent. more weight than any of the present steam locomotives, and it could pull the same weight at 50 per cent. higher speed. I think this type of electric locomotive is the stepping stone between the steam locomotive and the electric locomotive operated from a distant central station. To properly try the experiment of operating a high speed locomotive of 1,500-horse-power from a central station would undoubtedly cost nearly a million dollars. To try it with a locomotive of the Heilmann type would cost not more than $50,000 and if it proved successful, it is not much of a step to replace the boiler and constant speed steam engine with the moving contact and constant speed electric motor for driving the generator already tested and proven satisfactory.

THE MONOCYCLIC SYSTEM DISCUSSION.[1]—I.

BY DR. LOUIS BELL.

MR. J. F. KELLY: I suppose I can honestly begin by paying a tribute to the ingenuity of the devisers of the system; but it is scarcely necessary, because we all know what they can do—they have already proved themselves. I cannot help feeling, however, that in this case their ingenuity has been somewhat misapplied. The most serious fault with the system is that it did not come soon enough. If it had come before the polyphase systems had been worked out, perhaps we would not have needed any polyphase system, but, coming when it does, it seems to me a step backward. In the first place, the generator, as Dr. Bell explained, is substantially a single-phase generator. Now, in any given generator of given magnitude it is not possible to get the same output and regulation as it is from the polyphase—when worked single-phase as when worked two-phase. Dr. Bell seemed to think that the two-phase was in trouble, because of the difficulty of balancing the two circuits. I am more familiar with that system than any other, and my own reason for preferring it is because the regulation is better than if the work was thrown on one circuit. We have found that there is no more difficulty in balancing than in the Edison three-wire system. When it comes to the lines I suppose it is in this point that the chief advantage of the monocyclic system is supposed to lie; but the system requires at least three wires and any polyphase system does not require more. Where lights only and not power are required, it only needs two; in practice that is all that any polyphase does in any district where lights only are required. You need only run a pair of wires, so that in this respect there does not seem to be any gain in the monocyclic system, but the cost for copper is, at the least, according to Dr. Bell's diagram, higher than it is with the plain single phase, while the cost of copper in the two-phase three-wire system is very materially reduced. In the circular distributed I see it is stated that where power only is to be transmitted by means of the monocyclic system, the third wire is of the same section as the other two, making an addition of 50 per cent., but if the system is so working that this third wire is really a power wire and conveying energy, then there is not only this additional cost, but the percentage of drop in the circuits is increased beyond that in the single-phase system. As to the question raised by Dr. Bell in regard to the periodicity at which motors can be worked, there are undoubtedly great advantages in cases of long distances, or transmission with low periodicity, but one of them is not the possibility of operating motors. There is no difficulty in making polyphase motors of 16,000 alternations which will have high efficiency and start with large torque. As to the efficiency of the motor in the monocyclic system, there is nothing to be said against it, because the motor is substantially a polyphase motor, and whatever the polyphase motor will do the monocyclic will do.

MR. C. P. STEINMETZ: I can not quite agree with Mr. Kelly's statement that the single-phase alternating current system is antiquated and superseded by the polyphase system, and that therefore the monocyclic system is behind the times. The polyphase system has been before us now for nearly ten years. It made its appearance shortly after the single phase system, and at a certain time after the Frankfort exhibition, when our electricians came back from Europe and talked excitedly of what they had seen, and everybody seemed to think that the single-phase system would soon disappear altogether. Nevertheless we have now thousands of single-phase stations running, while the polyphase system is only just beginning to be used in special cases. Therefore I feel confident that the polyphase system will never be able to supersede the well-known single-phase system of old, but find that it possesses a limited application, although being very valuable at the proper place. The monocyclic system is entirely single-phase; that is to say, the total flow of energy issuing from the generator passes through zero and is fluctuating; while the polyphase systems share with the continuous system the common feature that the flow of energy is never at zero, but more or less constant. E. M. F's. of different phases or currents of different phases do not constitute the polyphase system; for in the ordinary single-phase system if an induction coil is connected in series to incandescent lamps you get E. M. F's. displaced from each other by 90 degrees, that is, quarterphase E. M. F.; and in a loaded transformer and in a transformer running light the currents are displaced in phase. In neither case, however, we speak of a polyphase system. The polyphase system is indicated when both E. M. F's. as well as currents differ in phase from each other.

Now, with regard to the statement of Mr. Kelly that the output of a polyphase machine is larger than that of a single-phase machine, that is a common mistake repeated now for years. It means that in the polyphase armature more wire can be put than on the single phase armature. However, the output of an alternator is not limited by the amount of wire you can put on the armature, but by the armature reaction; or rather, by that amount of armature reaction which can be taken care of by the field; and in a single phase machine you can, by compounding, take care of a very great armature reaction which you cannot take care of in the polyphase machine, where small armature reaction causes unbalancing of the circuit; in consequence of which the output of a polyphase is less than that of a single phase of the same size and speed; or at least not greater.

PROF. ELIHU THOMSON: The paper of Dr. Bell has been so full and so clear that it leaves very little for me to say, except that I can express my agreement with the statements of the paper, and that furthermore, after due consideration, I think Mr. Steinmetz has the right of it. He has given an enormous amount of time and attention and close study to the question of polyphase, single-phase and other systems, and has originated a number of remarkable combinations, one of which is the monocyclic system. I think the system undoubtedly accomplishes all that has been stated by Dr. Bell to be its advantages.

MR. C. F. SCOTT: I have been, and I am sure all of you have been, very much interested in the presentation which has been made by Dr. Bell of the monocyclic system. We can take it, I think, as a carrying out of the remark that was made in an association a year and a half ago, that when we have an alternating polyphase system, we have something we can do something with. It is flexible, we can twist it about, we can make a two-phase and three-phase system—and now a monocyclic system—variations of the polyhpase system, and go from one to another and get the different advantages which any one of these may present for different kinds of work.

We have had the characteristics and advantages and merits of this system pointed out. It may be well, it seems to me, to bring forward some of the questions which arise with respect to the points which have been brought out so that they may be answered now, and that we may determine the relation of this system to the other systems. To those who are not immediately and technically familiar with the subject, there is apt to be a sort of haziness about it. We hear first about the two-phase and then about the three-phase systems, as if they were entirely new and different. As a matter of fact there is no fundamental difference between the two. Then we have a monocyclic system. What relation does it bear to the other systems? Is it radically and entirely new? Does this euphonious name mean something which is a departure from what has gone before, or is it a modification, and if so, of what is it a modification?

Starting with the source, the generator itself is just now somewhat in doubt. The single-phase generator is best, because it regulates better and has a better output. The polyphase generator, it is also stated, regulates well and has a good output, and without carrying that further we can all be satisfied by taking our choice. We will consider a few points made with respect to the transmission circuits. There are one or two statements of Dr. Bell which can either be called in question or certainly a little modification made to them. A two-phase four-wire system, which he has given as the third figure, he has considered as the correspondent of the alternating two-wire circuit only, and has not considered it applicable to use in a three-wire connection, in which the amount of copper is so much less. The reason of this was the added complication of running two three-wire circuits. That might be true if the area to be covered were quite small, but as central stations are usually run the lines are carried out in different directions. In alternating stations there are anywhere from three or four to a dozen of several dozen feeding circuits running in different directions and supplying different territories. It is just as easy to divide these up into three-wire circuits for lighting, as the different parts of the city to be supplied, or the districts, are separated, as it would be if all of the circuits were of the same phase. If, therefore, the distribution can be carried on by the three-wire plan, the cost of copper here would be materially reduced and be made equal to that of

1. Paper read before the National Electric Light Association. See the ELECTRICAL ENGINEER, March 6, 1895.

the three-wire single-phase system. Considering the two-phase three-wire system, the figure 145.5 was stated as the relative amount of copper used, and that a possible reduction of 72.8 if the extreme E. M. F. can be increased above that for the first figure upon the diagram, which is for the two-wire single-phase system. The assumption upon which all these figures have evidently been made is that there has to be a definite E. M. F. for the carrying of lamps. If that is to be carried through the various diagrams, then the 72.8 is a proper figure. If, on the other hand, a limited voltage is the consideration to be met, we have in the ordinary three-wire circuit twice the E. M. F. of the single-phase circuit. If the same be applied to the two-phase three-wire circuits then the amount of copper would not be 72.8 but one-half, or about 36, so that the figure 145.5 in connection with that diagram is not in accordance with the assumption of the E. M. F. being controlled by the lamps in circuit, and if the highest E. M. F. allowed is that of the three-wire circuit, then the additional figure for the weight of copper for the two-phase three-wire system should be 36 in comparison with the other figures.

AN UNJUST PATENT STATUTE.

BY

Elihu Thomson

Now that decided attention has been called, by the decision of the Supreme Court of the United States, interpreting Revised Statute No. 4887, to the relations existing between patents taken out in the United States and abroad, it occurs to me that it would be interesting to note at this time some of the disadvantages under which the American inventor has labored in the past and under which he still labors, and not only in so far as it concerns the taking out of patents, but also in relation to the publication of new matter or the inventor's place in the history of an art.

While the decision of the Supreme Court makes it plain that the wording of the law in relation to the limitation of United States patents by foreign patents is to be taken instead of what would seem to me to have been the evident intent of the original enactment, I wish to point out some of the injustices under which the American inventor has suffered from this law, as it has been and is now interpreted, in comparison with inventors and workers abroad.

An American inventor making application for a patent has been and will still remain under the disadvantage of being required to perfect his United States patent before applying for patents abroad, and in order to secure valid patents abroad he must refrain from publication of any new matter which he may have discovered until such foreign patents have been obtained, as the mere publication nullifies the right to take a patent in most important foreign countries. But, it is practically impossible, as is well known, under our system of patent examinations, to control the time of issuance of a patent in the United States, and if the application should become involved in an interference, which is more than apt to occur with inventions of any considerable importance, the issuance of a patent may be tied up for an indefinite period of years. During this period there is every prospect of the same subject matter being worked upon abroad, or the matter becoming published, especially if the invention undergoes development in the United States. The inventor, therefore, if he desires foreign protection must take his foreign patents and stand the shortening of the term of the United States patent; or, if the interference proceedings or other delays last during the life of the shortest foreign patent, he receives a patent which has already expired when it issues, a "still-born" patent, so to speak.

Again, in the race between two interfering inventions the weaker party finding that he will probably lose the interference in the United States can easily transfer his scene of activity to foreign countries while the stronger party feeling that he does not wish to ruin his United States interest at the same time refrains from patenting abroad. In this case the party who is likely to come out ahead here does come out at the last without any foreign patents, while the other party to the interference may come out with several valid foreign patents but no United States patent.

Now, I do not think it requires any argument to show that the evident intention of the United States law when it was first passed was not to bring about this state of things and so handicap the honest American inventor. Nor is this all. The position of the foreign inventor, under the United States law, has been that he could make his applications in foreign countries whenever he felt like doing so and receive his patents, and, after an indefinite period thereafter, he was at liberty to apply for a United States patent and obtain a patent only limited by the shortest term foreign patent. Prior publication here would not affect his rights. Prior publication does affect the United States inventor's rights abroad. Does not this amount to a discrimination against the United States inventor; and would it not really tend, were there not other favorable influences, to discourage invention here?

But there is still another point which I consider of the greatest importance. Owing to the conditions under the law as it exists, the United States inventor, no matter what the importance of his work may be, is debarred from publishing it until the issuance of his United States patent, which may take a year or two in the Patent Office, unless he is ready to forego some of the years of its life by taking out foreign patents at once after his United States application has been filed. He is, therefore, under restraint as to publication if he wishes to protect his foreign rights at all.

And, let us ask, what has been the effect of this condition of affairs? Has it not been that an undue proportion of many new advances, especially in the electric art, has been first published abroad? Has it not been that publications of new material have often been made abroad when in fact the same subject matter had been worked out here, in some cases years before? Does it not result in the credit for new work or in the making of history, as it were, in a new art, being accorded in larger measure to workers abroad than would otherwise be the case? Now, suppose that instead of this law having existed at all, inventors who had made valuable discoveries or inventions were at liberty to apply for their United States patents and were equally at liberty to apply for at once and obtain, without prejudice to their United States rights, foreign patents on the same inventions. Then they might freely publish at once their work and obtain the credit for it to which they are entitled, and which under the present condition of affairs has often been taken from them on account of the enforced delay of waiting for the issuance of the United States patents before applying for foreign patents. I have known it to be the case, and I have not the slightest doubt that others actively at work in the electric field have had the same experience, that the first entrance into the electrical literature of some new and important advance has been through the foreign publications, when, in fact, the broad subject had been worked over and was known for a long time previously here, but was withheld on account of this unfortunate state of patent laws in this country.

The United States is entitled to take its proper place, not only in the actual work accomplished, but in the literature which naturally accompanies the work, and without such a restraint as now exists. The question arises, how long is the United States worker to be so handicapped, or practically put under a ban, by ill-considered laws? This is a question which I have often asked myself, and the answer to which, I have no doubt, has been sought by many who have experienced the same hardships.

THE BATE DECISION—A NOTABLE "SCOOP."

THE ELECTRICAL ENGINEER has often distinguished itself by the early publication of important news; and often by its exclusive possession. Last week it added to the long list of its "scoops" in this line by the being the *only* electrical journal that secured and published the text given out by Judge Harlan of the decision of the U. S. Supreme Court in the famous and important Bate case. More than this, although the decision was not read in Washington until midday Monday, the ENGINEER'S "Extra" was out in 24 hours, and on Tuesday afternoon was distributed all over New York by a corps of special messengers. The same day a large number were also mailed, so that the ENGINEER was the *first* and *only* American paper, daily or weekly, to give Judge Harlan's full text in every part of the country. No other electrical journal has yet published more than brief extracts, and some haven't even done that a week after. The regular issue of THE ELECTRICAL ENGINEER also contained an editorial on the subject, written with the full text in hand; and each copy of the paper was also furnished with the "Extra," bound in. If any of its readers needs more copies, it will be glad to send them. No other paper has it.

EDUCATIONAL.

PROF. CROCKER'S PUBLIC LECTURES ON ELECTRICITY.

A course of six public lectures on "How Electricity is now being Utilized," by Francis B. Crocker, E. M., Ph. D., Professor of Electrical Engineering, Columbia College, will be given in Room 11, Library Building, at the College, on successive Thursday evenings at 8.15 o'clock. These lectures will be very fully illustrated by experiments and are specially intended for professional and business men who desire to obtain an intelligent idea of the present uses of electricity. The subjects announced are as follows:

March 21.—How electricity is generated and stored; the principle and action of the dynamo and the storage battery will be shown and explained.

March 28.—Alternating currents; the greatest progress in electrical engineering is now being made in the use of alternating currents and this lecture will be devoted to showing the interesting phenomena and advantages of these currents.

April 4.—How electricity is used for lighting and heating; the principles of arc lamps, incandescent lamps, and electric heating (including cooking) apparatus will be shown and explained.

April 11.—The electric motor and its use in transmission of power; the lecture will cover the important forms of electric motors and the methods employed to transmit power by electricity, including the system now being installed at Niagara.

April 18.—Electric railways; the trolley, storage battery and conduit systems will be explained and illustrated by lantern slides, and the methods which will probably be used for rapid transit and very high speed service will be touched upon.

April 25.—The telegraph and telephone; the methods employed in telegraphy and telephony will be shown by working apparatus including the multiplex telegraph by which two or more messages are simultaneously transmitted over the same wire.

Tickets for the course, at $5.00, may be obtained of the Secretary of the President, Columbia College. Tickets will not be sold for single lectures.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRICAL SOCIETY.

A meeting of this society was held at Columbia College on March 7, Prof. M. I. Pupin in the chair. Mr. Charles S. Bradley read a paper entitled "Alternating currents and Their Relation to the Distribution of Energy." Mr. Bradley traced the history and evolution of the distribution of energy, and showed how nearly all work in this field was drifting towards the alternating current in some form or other.

The three-phase motor and its action were illustrated by a machine designed by Mr. Bradley and shown in operation. The armature of this machine was divided into two parts longitudinally, one part being wound with German silver and the other with copper bars set into the periphery of the armature core. The field is wide enough to span only one of these armature windings. When starting, the field is placed over the German silver winding, and, when up to speed, the field is slid bodily over until it surrounds that part of the armature containing the copper bar winding.

Mr. Bradley showed by a lever and balance that the starting torque of this motor was nearly three times greater with German silver winding than with the copper winding. The lecturer also exhibited a number of diagrams giving the results of tests and showing how the starting torque rises more rapidly at low periodicities than at high ones, and that the efficiency was very little affected by the substitution of a solid core for a laminated one. There was also exhibited on the lecture table a Dobrowolsky 3-phase transformer.

An animated discussion followed, which was participated in by Profs. Crocker and Pupin, Dr. C. E. Emery, Mr. Jos. Sachs and others.

LETTERS TO THE EDITOR.

CONDUIT EXPLOSIONS AND THEIR PREVENTION.

The many electric conduit explosions which have recently taken place and are becoming more frequent in all parts of the world, naturally set us all thinking as to what can be the actual cause for some of them. Therefore, in order to solve the problem, we must consider the subject matter in all its bearings, and I think, to do this, that explosions in electric mains should be classed under three headings, viz.:—1. Those that are brought about by carelessness which, of course, can be greatly reduced by more stringent rules being introduced and enforced to prevent them. 2. Those proved to be caused by short circuits, faulty fuses, corrosion, over-heating of the main cables, sparking, etc. 3. Those that frequently mysteriously occur, the cause of which as yet remains unsolved.

Many suggestions, from time to time, have been promulgated by several of our scientists both in England and abroad, but no one, so far as I can learn, has ever suggested or even hinted at what I believe to be one of the real causes that has brought about several of these disasters, which have frequently occurred in various parts of the country in a most mysterious way. My "theory" is that many of these explosions which have taken place both here and on the Continent during the past ten years have been brought about under certain atmospheric conditions, and are caused by lightning flashes being conveyed to the earth through lightning conductors which need not—in order to cause an explosion—"be fitted in the immediate vicinity where such explosions actually occur," for lightning waves are known to travel underground for miles until they reach or are absorbed by water or damp earth, both of which have a great affinity for electricity. Then again it must not be forgotten that the principal thoroughfares of all large cities in which the electric mains are laid, are composed of a compound substance of a semi-metallic nature consisting of earth and pulverized metals brought into existence by reason of the wear and tear of thousands upon thousands of tons of iron tires, carriage wheels, horse shoes and other pulverized metallic substances, into which compressed compound there is laid a network of gas, water and bare copper electric mains, a combination of which forms an absolute and complete passage for the conveyance of the flashing currents.

Therefore this is one of the problems which have to be solved amongst others, and some methods introduced by which explosions will be prevented, from this cause, in the future. I base my "theory" which I claim to be fundamental, on the fact that many mysterious explosions have occurred in districts where thunder and lightning have been hovering about in the vicinity at the time. Hence, I am convinced that this is one of the real causes which has brought about the actual firing of explosive mixtures, which naturally accumulate in the culverts and manholes of some systems.

I think I have hit upon a plan, provided my theory is proved correct, which will entirely overcome the whole difficulty, but I must refrain, for the present, from divulging the methods I intend to adopt, until the system is protected in the United States. I think Sir David Salomon's suggestion as to filling up the open spaces and man holes with small sand bags in order to prevent excessive accumulation of explosive gas, a very good idea, and his plan should be thoroughly tried as it will reduce the space and prevent undue accumulation. In England, Major Cardew has called special attention in his recent reports to the importance of using proper fuses, and it is to be hoped that the Board of Trade and also Insurance Offices will now insist upon contractors being more particular as to the type of main fuses, also fuse links, used by them, for undoubtedly to the slip-shod and make-shift manner this section of the industry is frequently scanted over—perhaps not wilfully but from a want of better knowledge relating to the subject of fuse wires and their fusing points which is often overlooked,—could be traced not only several explosions which have occurred in the mains but also many of the mysterious fires which have occurred in electric circuits by reason of these faults enumerated in Category No. 2, as above described.

It would be interesting to obtain the views of American engineers versed on this subject.

ARTHUR SHIPPEY.

LONDON, Feb. 22, 1895.

REPORTS OF COMPANIES.

THE ANNUAL REPORT OF THE COMMERCIAL CABLE COMPANY.

The statement of business transacted by the Commercial Cable Company for the year ending December 31, 1894, shows that notwithstanding the hard times and the fact that the new third cable was not completed until August, the usual dividend of more than 10 per cent. was paid, and $310,439 was carried to surplus. Early in the year the last remaining $400,000 of debentures were cancelled, leaving the stockholders in possession of the property, unincumbered and free from fixed charges of any kind.

Without increase of capital stock the value of the company's plant has been increased to $12,250,000 by the addition of the new main Atlantic cable, by the extension of the Canso-New-York cable from the landing-place at Coney Island through the harbor to this city, a distance of fourteen miles, and by the acquisition of wharf property and real estate at Halifax.

The policy of using the surplus earnings after paying 7 per cent. dividends for liquidating the bonded debt has resulted in wiping out the interest charge, which originally was $180,000, and last year the company received $44,000 income from its investments, making a difference of $224,000 in five years. Following is the balance sheet on December 31, 1894:

ASSETS.

Plant	$12,250,000
Bonds and stocks	1,592,820
Debts and traffic balances	527,717
Cash at banks	671,368
Total	$14,741,905

LIABILITIES.

Capital stock	$10,000,000
Dividend payable January 2, 1895	175 000
Debts and traffic balances	189,490
Reserve fund	1,592,820
Assets over liabilities	2,784,595
Total	$14,741,905

The following named directors have been elected: John W. Mackay, James Gordon Bennett, Sir William C. Van Horne, Gardiner G. Howland, Charles R. Hosmer, George G. Ward, J. W. Mackay, jr., A. B. Chandler, Richard Irvin, Sir Donald A. Smith. Thomas Skinner, George S. Coe and E. C. Platt.

HIS PREFERENCE.

A subscriber writes:—"I like your paper better than the —— or ——. I get all every week, so can compare them."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 5, 1895.

Alarms and Signals:—

Burglar Alarm for Glass Doors, J. B. Gill, San Francisco, Cal., 535,100. Filed Feb. 27, 1893.

The glass has a thin strip of metal around its edge and the circuit is closed by moistened pads, the breakage or removal of the glass opens the circuit.

Train-Signal for Railways, A. H. R. Gulley, South Easton, Pa., 535,332. Filed Jan. 22, 1894.

Conductors, Conduits and Insulators:—

Insulating Conduit for Electric Conductors, L. B. Stillwell and C. F. Scott, Pittsburg, Pa., 535,084. Filed Oct. 25, 1894.

Claim 1:

A conduit for electric conductors comprising a plurality of non-conducting-telescoping tubes made in abutting, joint-breaking sections, and a non-conducting liquid filling the spaces between the tubes and around the conductor.

Winding or Taping Machine, H. E. Heath, Windsor, Conn., 535,107. Filed May 17, 1894.

So arranged that the tape may be applied to the coil in overlapping layers obliquely to the peripheral line of the coil.

Drying Electric Cables, C. H. Rudd, Chicago, Ill., 535,173. Filed April 18, 1892.

Claim 1:

The herein described method of removing moisture from the cores of cables provided with a protecting sheath, which consists in heating the completed cables in an oven from which the air is not exhausted, and simultaneously maintaining a vacuum within the sheath surrounding the core of the cable.

Distribution:—

Transformer, F. S. Hunting, Fort Wayne, Ind., 535,010. Filed Feb. 25, 1892.

The invention comprises a system of magnetic circuits resulting from two or more alternating currents of differing phase, two or more of the magnetic circuits being grouped to develop in the secondary coils phasially different secondary currents.

Method of and Apparatus for Regulating Electric Circuits, J. M. Bradford, Portland Me., 535,158. Filed Jan. 9, 1894.

Claim 1:

In an electric regulating apparatus, the combination of a current varying device, an electromagnet with differential winding to govern the movements of said current-varying device, electric circuits and a device responsive to variations in the current to be regulated to control action of said magnet, and driving-gear to move said current-varying device progressively.

Dynamos and Motors:—

Armature Winding Machine, H. E. Heath, Windsor, Conn., 535,104. Filed May 15, 1894.

Machine for winding and taping armature coils or closed rings.

Apparatus for Winding Armature Coils, H. E. Heath, Windsor, Conn., 535,-105. Filed May 15, 1894.

Details of the above.

Method of Forming Armature Coils, H. E. Heath, Windsor, Conn., 535,106. Filed May 15, 1894.

The wire is first uniformly wound to a particular form and subsequently re-shaped to form a completed coil ready to be applied to the armature coil.

Galvanic Batteries:—

Electric Battery, H. J. Brewer, New York, N. Y., 535,090. Filed May 2, 1892.

The zinc is supported by a screw thread held by a plug in the cover.

Lamps and Appurtenances:—

Electric Arc Lamp, H. P. Davis, Pittsburg, Pa., 535,051. Filed Oct. 28, 1893.

Improvements in detail of construction.

Electric Arc Lamp, H. P. Davis, Pittsburg, Pa., 535,052. Filed May 3, 1894.

The lamp is subject to the exclusive control of a shunt coil, with a perfectly uniform and continuous pull due to the series coil in opposition to the pull of the shunt coil.

Light Fixture or Analogous Article, W. McElroy & G. W. Bayley, Brooklyn, N. Y., 535,069. Filed May 9, 1891.

The object is to obtain a light fixture with an improved insulating coupling.

Incandescent Electric Lamp, F. L. Fowler, Philadelphia, Pa., 353,199. Filed July 30, 1894.

The bulb of the lamp is flanged and threaded so that it can be removed for the insertion of a new filament.

Electric Lamp Support and Cut-Out, L. Johnson, New Albany, Ind., 535,336. Filed April 5, 1894.

Intended for arc lamps suspended over the streets from span wires.

Miscellaneous:—

Demagnetizing Apparatus, C. Houlgrave, Buffalo, N. Y., 535,060. Filed Jan. 22, 1894.

The object to be demagnetized is placed within a coil through which reversed currents are sent, the coil being surrounded with laminated iron parallel to its winding.

Advertising Device, J. Montagner, Buenos Ayres, Argentine Republic, 535,067. Filed Dec. 15, 1894.

Displays advertisements simultaneously with the street or station which the vehicle passes.

Cooking and Heating Apparatus, H. G. O'Neill, Boston, Mass., 535,072. Filed Feb. 8, 1894.

A range is provided with a pair of grooves which are for a portion of their length provided with contact surfaces and the remaining portions not so provided; the heating coil is slid in these grooves mounted on a contact slider.

Circuit Interrupter for Alternating Electric Currents, H. N. Potter, Allegheny, Pa., 535,077. Filed Feb. 28, 1894.

Claim 1:—

In a circuit interrupting device, containing a number of points of circuit interruption, a shunt around one or more of said points of interruption, and a device in said shunt tending to counteract the effect of current lag in producing an arc.

Lightning-Arrester, A. Wurts, Pittsburg, Pa., 535,086. Filed Feb. 28, 1894.

Improvements in construction on inventor's non-arcing lightning arresters, to permit of easy transportation and safe handling.

Electrolytic Conduit for Beer or other Liquids, L. Wagner & J. Marr, Baltimore, Md., 535,267. Filed Nov. 12, 1894.

Consists of a conduit section composed of glass and opposing electrodes having transversely ribbed faces, leaving a central narrow sinuous space between the electrodes for the passage of the beer, while being electrolyzed.

Electric Heater or Rheostat, J. H. Delany, New York, N. Y., 535,321. Filed Nov. 23, 1894.

Claim 1:—

In an electric heater or rheostat, a non-conducting base or support of tiling, porcelain or such like material, a heating or resistance conductor arranged thereon, and a layer or coating of vitreous enamel intimately united with the base or support and attaching the conductor thereto.

Railways and Appliances:—

Rheostat, A. J. Shaw, Muskegon, Mich., 535,027. Filed Dec. 1, 1894.

A combined reversing switch and rheostat for electric railways, embodies novel constructions looking to compactness, freedom from sparking, grounding, etc.

Contact Device for Conduit Electric Railways, F. E. Lodetti, Rondout, N. Y., 535,214. Filed May 4, 1894.

The vehicle carries an elastic guide and a collecter suspended therefrom which makes contact with a spring supported device attached to the main conductor.

Closed Conduit for Electric Railways, P. Murphy, Chicago, Ill., 535,291. Filed Jan. 9, 1894.

The conductor is covered by a supplementary conduit with hinged sides which separate at the top to allow of contact as the car passes.

Sectional Conductor System for Electric Railways, A. Rosenholz, San Francisco, Cal., 535,297. Filed Oct. 11, 1894.

Mounting for Electric Motors, E. A. Sperry, Cleveland, Ohio, 535,304. Filed April 18, 1894.

Claim 1:—

In a power transmission for vehicles, a bi-axled running gear, a motor connected with each axle and extending therefrom in such a manner that its centre of gravity shall pass through a line at one side of the axle, an arm extending from one motor to the other pivotally attached thereto at a point in substantially a vertical line above the said centre of gravity upon one motor, and below such centre of gravity upon the other motor.

Electric Railway Conduit, W. T. Dulany, Jr., New York, 535,324. Filed Dec. 14, 1894.

Motor Truck, E. A. Sperry, Cleveland, Ohio, 535,508. Filed June 5, 1893.

Claim 1:—

A motor truck comprising a frame, shafts geared to the axles and supported by said frame, but laterally movable with relation thereto, supports for a motor within said frame, and means for coupling the motive shaft of the motor to said shafts whereby the action of said motive shaft is transmitted to the axles.

Switches, Cut-Outs, etc.:—

Switch, C. S. Van Nuis, New Brunswick, N. J., 535,149. Filed Sept. 17, 1890.

Employs a shunt for the main switch contacts which is maintained until after the main contacts are separated.

Telegraphs:—

Type Writing Machine Attachment, C. Spiro, New York, N. Y., 535,179. Filed Oct. 9, 1894.

Provides an attachment by which Morse signals corresponding to the letter are produced when the typewriter key is depressed; the attachment is mounted directly on the key lever.

Combined Telegraph and Telephone System, C. A. Shea, Boston, Mass., 535,299. Filed Jan. 3, 1893.

Consists of two telegraph lines, an interposed converter around which both lines are coiled and condensers between the lines to complete the telephone circuit, and between the converter and telegraph instrument.

Telephones and Apparatus:—

Telephone Apparatus, O. L. Wullweber, Chicago, Ill., 535,042. Filed Jan. 7, 1893.

Apparatus intended to support and adjust the receiver and mouthpiece of the transmitter.

Battery Telephone-Transmitter, W. W. Jacques, Newton, Mass., 535,247. Filed June 22, 1894.

Claim 1:—

In a telephone transmitter an electrode or variable resistance medium consisting of metal with its surface converted into one of its own salts.

Telephone-Transmitter, J. & H. M. Goodman, Louisville, Ky., 535,284. Filed Sept. 19, 1894.

Consists in details of construction of a transmitter in which comminuted magnetic material placed between two magnet poles forms the variable resistance.

Telephony, W. W. Jacques, Newton, Mass., 535,289. Filed May 26, 1892.

Passes through a multitude of loose contacts in a circuit current sufficient to maintain the contacts in continuous rapid vibration and superimposes upon such vibrations the vibrations due to sound waves.

LITERATURE.

National Electric Light Association, 17th Convention, Washington, D. C., February 27, to March 2, 1894. Published by the Association.

This is a very handsomely printed volume, containing the proceedings of the Washington Convention, which brought out a number of papers of more than ordinary interest. Among these may be mentioned the papers on "Polyphase Transmission" by C. F. Scott, and on "Switchboards for Modern Central Stations," by A. B. Herrick. The volume also includes the stereopticon lecture by T. C. Martin and Luther Stieringer on "The Electric Lighting of the World's Fair and Some of Its Results," which is embellished by a number of excellent engravings of some of the night views shown at the time. The frontispiece bears a strikingly faithful portrait of Judge E. A. Armstrong, President of the Association during that Convention year.

ANOTHER POWER HOUSE DESTROYED.

The electric power house of the Chicago and North Shore Electric Railway, at Edgewater, has been burned. The dynamos and most of the motor cars were destroyed. The offices of the company were also located in the building. The loss is estimated at $150,000.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

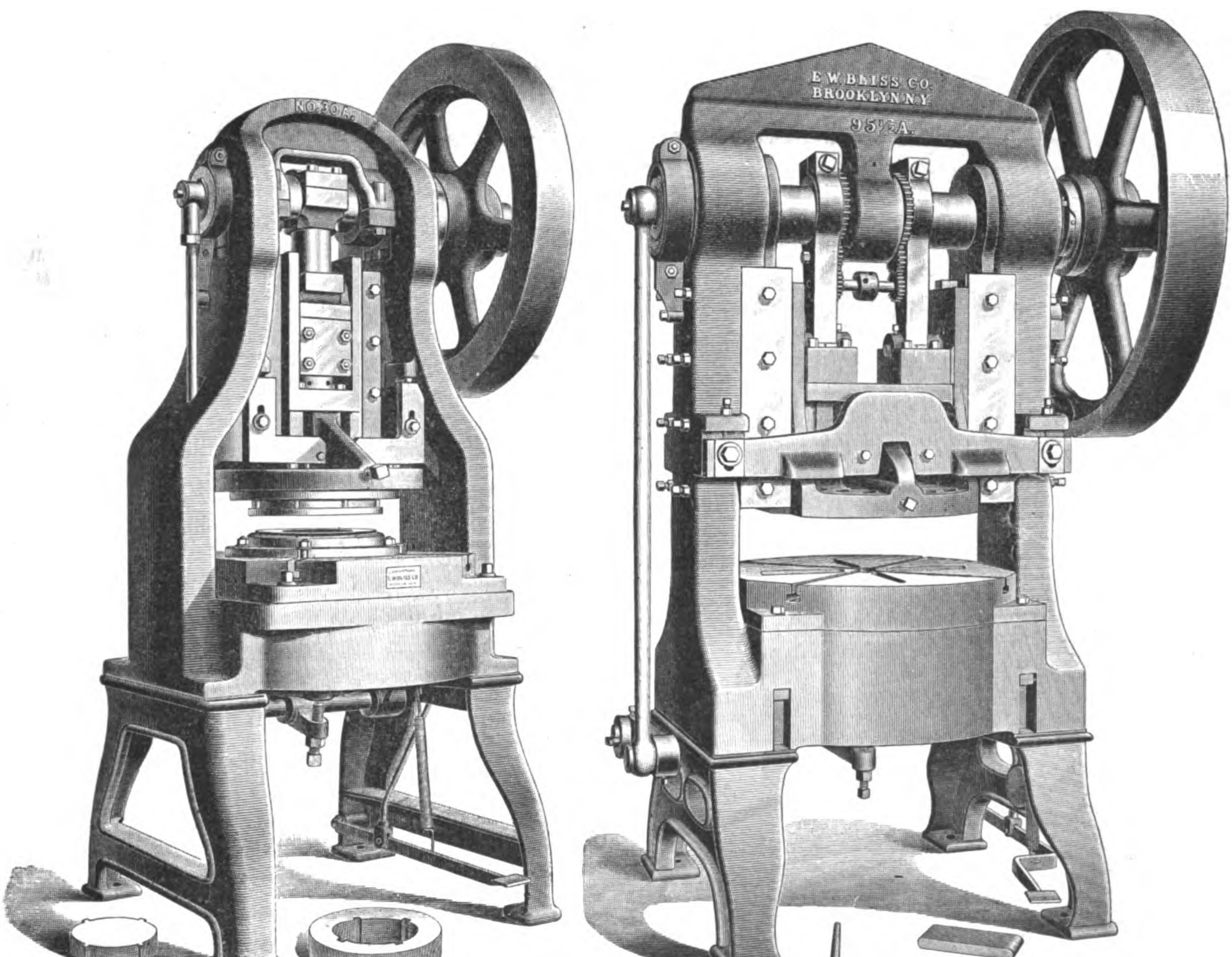
BLISS ARMATURE CUTTING PRESSES.

The requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet metal work. The usual form of armature is made up of annular discs, with notches on the outside or inside circumferences. As it is essential to have the outside and inside exactly concentric it has been found best to adopt dies which, by cutting them simultaneously, eliminate the inaccuracies which are almost unavoidable when the cutting is done in two or more operations. In most cases, the notches and key slots are also punched at the same time, all of which calls for tools having "throw-out pads," in addition to the cutting parts, so as to automatically push the discs and scrap out of the dies and punches.

These throw-out pads are usually operated by means of heavy springs, which are not only far from reliable, but consume a great deal of the power of the press. The two presses shown in the accompanying illustrations are designed to operate these throw-outs in a positive manner, and consume but little of the power of the press. It will be seen that, in addition to the usual slide carrying the punch, there is a bottom slide, actuated by an outside crank connection and which operates the dies and throw-out pads through the radial slots in the bolster. Two cross pieces, adjustably attached to the frame of the press, actuate the throw-out pads of the punches by striking against them on the return motion of the main slide.

The No. 30 A press, shown in Fig. 1, is more particularly designed for cutting simultaneously the inside and outside of plain rings, with or without key notches, such as are shown on the floor in the illustration. These presses will work up to about 20 inches in diameter in this class of work. These rings or discs are then subsequently notched in a notching machine. The No. 95½ A press, Fig. 2, on the other hand, is used for cutting the whole disc, including all the notches, at one blow, and can be used for that class of work up to 11 or 12 inches in diameter. Beyond that size, this press is usually furnished with back gearing and sometimes with a body casting of steel, instead of cast iron. It can, however, be also used for plain rings and, in that case, is designed to take in diameters up to 24 or 30 inches. It is also a useful machine for cutting the smaller sections for armatures of large generators, in which case the outside of the sections and the holes in same are mostly punched simultaneously.

The illustrations show two of a series of similar machines, made by The E. W. Bliss Company, Brooklyn, N. Y.



Figs. 1 and 2.—The New Bliss Armature Cutting Presses.

SOUTHERN NOTES.

Electric Lights, Cuthbert, Ga.—Mayor and Council have concluded to defer putting in an electric light plant, for the present, notwithstanding the favorable issue of $10,000 in bonds, for this purpose. They propose waiting until later in the year, and putting it in then, provided a franchise is not granted several individuals and firms, who are now corresponding, with this end in view. The Mayor and Council are entertaining propositions to put the plant in under franchise, etc. Sealed proposals are being invited Tuesday March 19, for a complete system of water works for Cuthbert, by the Board of Water and Electric Light Commissioners of which the Mayor is Chairman. The Mayor will furnish specifications upon application. R. L. Moye, Mayor.

Cook, Horne & Co., North Howard Street, Baltimore, Md., have been awarded the contract for furnishing two automatic Ball high speed engines for the electric lighting plant for the Catholic University near Washington, D. C.

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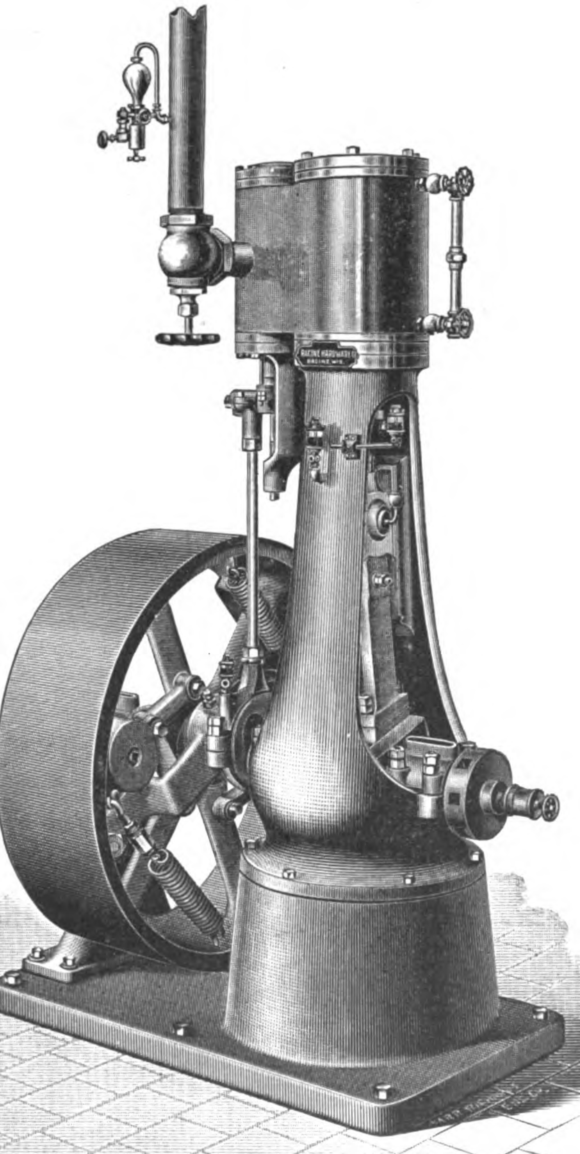
Persistent but unconfirmed rumors were in circulation on Monday that Standard Oil capital is interested in a plan to buy out both the General Electric and Westinghouse interests and consolidate them.

NEW RACINE AUTOMATIC ENGINE.

During the past three or four years the Racine Hardware Company have made several changes and improvements in their well known automatic engines, tending to still further increase their efficiency and reliability. Our illustration shows their latest type of vertical engine, which they are now building in sizes of from 1 to 100 H. P., the horizontal type being built from 30 H. P. up to 100 H. P. These engines are of the "self contained" type, and are especially adapted for electric lighting and other purposes where high speed in connection with economy and close regulation is desired.

The frame is rigid and of tasteful design. The cross head slides as well as the broad boxes for the shaft are cast solid in the frame. The connecting rod is cut from a steel forging and provided with



NEW RACINE AUTOMATIC ENGINE.

ample means for taking up wear at both ends. Shaft, crank and crank-pin are made from one steel forging. The crank-pin is lubricated by an improved method, using a compression grease cup and forcing grease through the short end of the shaft. The cup can be detached, filled and replaced while the engine is running at full speed. The shaft is supported by three bearings, two in the frame and one outside of the governor pulley, beyond which the shaft extends far enough to attach an extra pulley.

The valve is perfectly balanced and fitted with rings. The cross head shoes are made with large bearing surfaces. The governor is of an improved type. All castings are of the best charcoal iron. The best fittings are furnished with each engine. Besides the vertical and horizontal engines, the Racine Co. make an automatic outfit, stationary and marine, from 1 to 6 H. P. This outfit has a vertical automatic engine and porcupine boiler. These are on one base and have feed water heater, pump, oil burner, feed water regulator, air pump and all piping to make the outfit complete, besides all fittings for the engine and boiler.

The boiler is fitted with a combination grate whereby coal, wood and oil can be burned. With oil, 150 pounds of steam can be raised from cold water in ten minutes.

This company has in press a new edition of its catalogue.

Copies will be mailed to prospective purchasers upon application to W. F. Parish, Gen'l. Sales Mgr. Racine Hdw. Co., Home Ins. Bldg., Chicago.

THE WALKER MFG. CO.'S ORDERS.

Among some of the larger orders taken already this year by the Walker Manufacturing Co., Cleveland, Ohio, may be mentioned the following: The Complete Electric Construction Co., New York City, 2 50 K. W. belted lighting generators; the Rahway Electric Railway Co., Rahway, N. J., 1 100 K. W. belted multipolar generator, 3 double car equipments, 25 H. P. spring mounted steel motors; the Philadelphia Construction Co., Philadelphia, Pa., for the Schuylkill Electric Railway Co., Pottsville, Pa., 3 400 K. W. belted generators and switch board apparatus, 2 double car equipments, 25 H. P. motors; the Michigan Electric Co., Detroit, Mich., for Saginaw Consolidated Street Railway Co., Saginaw, Mich., 1 200 K. W. belted generator, 6 complete car equipments, 25 H. P. motors; Hartford & West Hartford Street Railroad Co., Hartford, Conn., 2 double car equipments, 50 H. P. steel motors, 2 double car equipments, 25 H. P. steel motors; C. E. Loss & Co., Chicago, Ill., for Waukesha Street Railway Co., Waukesha, Wis., 1 150 K. W. belted generator, 3 double car equipments, 50 H. P. steel motors; the Detroit Railway, Detroit, Mich., 2 400 K. W. direct coupled generators, 1 750 K. W. direct coupled generator; Gloucester, Essex & Beverly Street Railway Co., Gloucester, Mass., 2 225 K. W. direct coupled generators; the Worcester Construction Co., Worcester, Mass., for the Gloucester, Essex & Beverly Street R'y Co., 16 double car equipments, 25 H. P. steel motors; Jaspar County Electric Railway Co., Carthage, Mo., 2 200 K. W. belted generators, 5 double car equipments, 30 H. P. steel motors. Besides the above they have taken orders for their spring mounted steel motors for the Louisville Railway Co., Louisville, Ky., Atlantic Avenue Railway Co., Brooklyn; Ottumwa Electric R'y Co., Ottumwa, Iowa; Aurora Street Railway Co., Aurora, Ill.; Bloomington City Railroad Co., Bloomington, Ill.; Steinway Railway Co., Brooklyn; Kansas City Railway Co., Kansas City; Atlanta Electric Railway Co., Atlanta, and many others.

They have also taken large orders for their general work, among which might be mentioned contract for four 2,000 ton hydraulic cotton compressors for Mr. W. W. Bierce, Montgomery, Ala.

THE NEW YORK AND BROOKLYN TUNNEL COMPANY.

The New-York and Brooklyn Tunnel Company has been incorporated with a capital of $100,000, to build an underground railroad to be operated by electricity or other motive power from a convenient point in New-York City between East Sixteenth and Whitehall Streets, under the bed of the East River to a point in Brooklyn between North Eighth Street and Atlantic Avenue, a distance of two miles. The Directors are: Thomas A. Patterson, Jr., Charles J. Schlegel, Walter J. Aims, John C. Bucken, Charles Kuehnmundt, John V. Bouvier, Jr., Frederick P. Delafield, Frank H. Knight, and Samuel S. Slater, all of New-York.

THE HELIOS ALTERNATING ARC LAMP.

Alternating arcs have made surprising headway in this country within the last year or two, and this is very largely due to the work of the Helios Electric Co. of Philadelphia. All who attended the recent convention were struck with their fine exhibit made under the supervision of Mr. F. S. Marr, president of the Company,—an exhibit which was not merely commercial but educational, the arc itself being projected upon a white screen where everybody could see the beautiful steadiness and evenness of the light for themselves. Not only were people impressed with the beauty of the Helios light, but after hearing so much about noisy alternating arcs, many of the spectators were surprised to find that in this case the lamp was as quiet as it was brilliant. The demand for the Helios specialties is rapidly on the increase, and there is good reason to believe that ere long alternating arcs will be one of the largest factors in the business. In Europe, the Helios lamp has a wide celebrity, and it would indeed be strange if its merits failed of appreciation here.

POUGHKEEPSIE, N. Y.—The Poughkeepsie Electric Light and Power Co. have placed the contract for their new plant with the Berlin Iron Bridge Co., of East Berlin, Conn. The engine and dynamo room will be 61 ft. wide and 172 ft. long and the boiler room 77 ft. wide and 60 ft. long. The whole will be covered with the Berlin Iron Bridge Co.'s patent anti-condensation corrugated iron roofing.

R. B. COREY.

Under the above familiar name, a new business has been established at 714 Havemeyer Building, Cortlandt street, by Mr. R. B. Corey, formerly of the Electric Supply & Construction Co. For many years past, Mr. Corey has been engaged in the development of arc lights, especially for constant potential circuits, and in his new enterprise he will have as an associate Mr. John C. Knight, the inventor of many lamps of this type. The concern has ready and offers for sale a large line of constant current and constant potential arc lamps; lamps for railway circuits; twin lamps; focussing lamps, etc., etc. These embody the latest ideas and principles and will be marketed at reasonable prices. Mr. Corey also has the handling of a choice make of imported carbons, which he guarantees for smoothness in consumption and for long life. He will be glad to enter into correspondence with any company or firm needing lamps or carbons, and is ready to furnish lamps of special make or in original decorative designs at short notice. It is not necessary to bespeak for Mr. Corey the good will of the trade; he has it already in large measure, and proposes to do all he can to deserve even more of it under new conditions.

DYER & DRISCOLL.

The patent law firm of Dyer & Seely, 31 Wall Street, this city is so well known that changes in its personnel are noted with interest throughout a wide circle. It is with regret, therefore, that we note the retirement of Mr. H. W. Seely from ill health; and we hope to learn of his perfect restoration. The remaining members of the firm will continue, and owing to the closing up of some of the old suits in which their time was fully occupied at the bar, they are enabled to resume actively their work in the department of patent soliciting, for which they have special qualifications. Mr. R. N. Dyer has practically done the whole of Mr. Edison's patent work since 1881, and had direct charge of the Lamp and Feeder and Main cases, which rank among the most notable of the period. Mr. D. H. Driscoll has been associated with the firm seven years, devoting his attention to the non-electrical patent cases, and prior to that had served seven years in the office of the famous old patent lawyer, George Gifford, to whose hands some of the old electrical patent litigations were entrusted. It will be seen that both gentlemen are peculiarly qualified by training, experience and ability to undertake with satisfaction to their clients any work relating to patents; and we believe that many of our readers will be glad to avail of the opportunity.

NEW RAILWAY LAMP.

THE AETNA ELECTRIC WORKS, of Hartford, Conn., have recently put on the market a new railway lamp which embraces some new features, and which they claim has 50 per cent. more life than any other lamp manufactured. Two reasons are attributed for this result, first, the peculiar method of anchoring the filament, which is doubled up on itself, and giving it a stability unknown before, and secondly, the necessary test for tensile or breaking strain which the filament undergoes, when being given its peculiar shape. The filament will retain its original shape independent of the angle at which it is turned, and the peculiar method of anchoring is patented. The lamp is intended also for 110 volt circuits, is much shorter than ordinary lamps, and can be installed completely inside of the ordinary shade in general use.

ELECTRIC LIGHTING SUPPLIES WANTED.

The Prescott Electric Light and Power Co., of Prescott, Arizona, has recently been formed with a capital stock of $40,000. Mr. J. D. Moore, the president and general manager, writes that the following apparatus and supplies are wanted: One 60-light arc dynamo, one 150 H. P. engine, 50 long distance telephones and five miles of No. 6 wire.

WESTERN NOTES

MR. L. H. ROGERS, Ass't. Mgr. Brush Electric Co., paid Chicago a short visit last week.

MR. W, C. BRYANT, of the Bryant Electric Co., paid Chicago a short visit before returning east from the Cleveland convention.

THE CHICAGO CROSS ARM CO. have found it necessary to procure larger and more suitable quarters, and are now located in suite 1440 & 1441, Monadnock Block, Chicago.

PROF. A. GRAHAM BELL, whose success as an educator of deaf mutes is probably as great as his achievement in telephony, addressed a company composed principally of deaf people, in the rooms of the board of education, Chicago, on the 6th inst. He spoke in favor of the establishment of day schools for the deaf. His principal argument for the day school system was that it brings the deaf and dumb into contact with the hearing and speaking, thus enabling them to keep in closer touch with human kind.

THE METROPOLITAN ELECTRIC COMPANY of Chicago are introducing to the trade a new carbon battery of high efficiency test for open circuit work. The battery is guaranteed and offered to the trade seeking a high class article of this description.

MR. GEO. S. WHYTE who for the past eight years has been connected with the Washburn & Moen Mfg. Co. has severed his relation with that Company and will hereafter act as selling agent for several first class concerns in the electrical and kindred supply line.

THE ONONDAGA DYNAMO CO. have opened a Western Office in the Monadnock Block, Chicago and have appointed Mr. L. W. Collins Western Manager. This we are informed will in no wise affect the business of Lee & Collins, which will be continued as heretofore.

CUTLER & HAMMER, Chicago suffered a serious loss by fire last week, their shops being located in the Kaestner Block, the destruction of which took place on the 27th ult. The loss of Cutler & Hammer is placed at $8000. The firm will resume business as soon as practicable.

THE METROPOLITAN ELECTRIC CO., Chicago are sending out a new circular containing some flattering testimonials from users of P. & B. Insulating materials. In nearly every instance the parties writing speak of having used P. & B. for years and with very satisfactory results.

THE ELECTRICAL ENGINEERING COMPANY, of 249 Second avenue, south, Minneapolis, Minn., have issued their catalogue No. 3, containing no less than 298 closely printed pages. The table of contents alone occupies more than four solid pages of two columns each and includes electrical supplies of all kinds for electric lighting, street railways and house wiring.

THE TELEPHONE EXCHANGE is the title of a handy little pamphlet just published by the Harrison Electric Co., Chicago. The Author is Dr. E. M. Harrison, formerly Chief Electrician of the Harrison International Telephone Company. The book is full of useful information to all managing or maintaining telephone exchanges.

THE DIAMOND TRANSFORMER is one of the Central Electric Company's specialties that seems to well illustrate the company's determined policy of handling only goods of undoubted merit. Their transformer sales, we are informed, show a gratifying increase from month to month, and a large list of satisfied users speak in high terms of the efficiency and regulation of the "Diamond."

OTTAWA, ILL.—Mayor Schoch has notified the Ottawa Electric Street Railway Company, that unless it operates all of its tracks in Ottawa before April 1st, its franchises will be forfeited, and it will be prevented from doing business in Ottawa. Some time ago the company offered to sell the entire plant for $40,000, but later, when the deal was about completed it annulled the agreement and refused to sell.

A NEW CUSHMAN TELEPHONE CO.—Articles of incorporation were filed at Springfield, Ill. on the 26th of Feb. for the Cushman United Telephone Company at Chicago. The company is capitalized at $20,000,000 to build telephone and telegraph appliances. The incorporators are I. M. Cushman, O. O. Leabhart and Joseph Barton. The directors are S. D. Cushman, W. C. Dean, James Falley, L. H. Chatterton, Lewis H. Falley, William Falley and John E. Crawford. It is stated that the Company will confine its business for the present to small cities and the country.

ELECTRIC MAIL DELIVERY in Chicago lies, it seems, as far in the distant future, as it did before the council granted Mr. Sherman permission to try the experiment of transporting mail bags over a *single* overhead wire by means of an electric motor arrangement, the construction of which no one, except the inventor, has any detailed description of. It is stated that the requirement under the permit of the inventor to file an indemnifying bond, to the property holders and the city, has caused the inventor to abandon the project.

THE HEINE SAFETY BOILER CO., of St. Louis, has closed contract for 1332 H. P. for the new high duty dredge boat which the Government has just contracted for. The boat is for Ohio and Mississippi River service; is of about 1000 tons burden, will be equipped with the highest grades of machinery and is expected to make quick work with sand bars. The Heine Co. feels particularly complimented in the choice of its boilers. The points of advantage in the Heine boiler which influenced its selection, were its compactness, giving maximum power in minimum space, its economical use of fuel, involving smaller stocks of coal, but chiefly its ability to operate on extremely muddy water just as it comes from the river. The special Heine mud drum permits deposit and removal of a large percentage of sediment in water before it gets to the boiler proper.

THE COSMOPOLITAN ELECTRIC Co. is the name of a new Chicago concern of mysterious antecedents and dubious future, to which the aldermen have recently given "free, gratis," an all-inclusive franchise for electric light, heat, power, telephony and anything else that a blanket ordinance could embrace. The franchise is to run for fifty years, for 3 per cent. of the gross receipts after the first five years. It is stated that the Harrison International Telephone Co. is interested in the telephonic part of the proposed Cosmopolitan grant. There is, of course, talk of an early veto, but it will be interestang to wait and watch developments.

THE ELECTRIC APPLIANCE COMPANY is rejoicing over the decision in the Bate Refrigerating Case. It is of particular value to them as it enables them to be in the market again with the old reliable Packard lamp with platinum leading-in wires for which the trade has been clamoring for the past two years, but which they have been unable to supply owing to patent litigation. Where the merits of the old lamp are known, the Electric Appliance Company state that a simple mention of the above facts brings in the business which is already coming in a way that is making them decidedly happy.

NEW YORK NOTES.

GEO. L. COLGATE Co., 136 Liberty street, are making special quotations on McIntosh paint for poles, buildings, bridges, &c.

THE NIKOLA TESLA Co. has certified its increase of capital from $5,000 to $500,000.

PRESIDENT INSULL, of the Chicago Edison Co. was a visitor to New York last week, and was among those who saw Mr. John Kruesi off for Europe.

H. E. HAWES, 393 Pearl street, is pushing the sale of his "hypnotizer," in which a little concealed motor in a box operates a beckoning finger. It is said that any person seeing one of these in a store window, is induced at once to "come in" and spend all his or her money.

MR. JOHN KRUESI, the manager of the big General Electric works at Schenectady left for Europe last Saturday by the "Werra," to take a well earned rest of several months. It is reported, however, that Mr. Kruesi will avail himself of the opportunity to study European methods of producing electrical machinery. There is certainly no man better qualified to make a study in this direction, of relative methods.

THE CURTIS ELEC. MFG. Co. make a most inviting announcement as to the proposed sale of their Jersey City factory, motor patents, material, stock in hand, etc. The time for proposals closes Mar. 16, and the opportunity is a most excellent one to secure a going factory on good terms. The Curtis railway motors have a splendid record for efficiency and stability and to-day are doing work that is unexcelled.

THE INTERIOR CONDUIT & INSULATION Co. on March 15 will remove their general offices from 44 Broad street to their large factory 527-531 West Thirty-fourth street, which will henceforth be their headquarters. The demand for the Company's products is larger than ever, and all lines are well patronized. Conduit everybody wants, and the Lundell dynamos, motors, etc., are welcome standard specialties everywhere.

THE GOUBERT MFG. Co., of 14 and 16 Church street, have issued a neat little folder containing the report of an efficiency test made by Prof. R. C. Carpenter, at Sibley College, recently. The result of using the separator was found to be 99.2 and 99.4 per cent of dry steam, as the quality of the steam after passing through the separator. In one instance steam at 76 pounds pressure, having 15.6% moisture in the steam, had only 0.6 after it had been wrung dry in the separator. This seems to be the sort of apparatus that owners of high speed engines are looking for.

THE GOULDS MFG. Co., of Seneca Falls was the successful bidder for triplex power pumps, boilers and engine for the new water works at Canandaigua, N. Y. This is to be an electrically operated pumping station, the plant consisting of a power station in Canandaigua and a pumping station 3½ miles distant on the shores of Lake Canandaigua. The triplex power pumps which the Gould Mfg. Co., will use for this plant have 12-inch cylinders, 12-inch stroke and capable of delivering 1,000,000 gallons per day each. They will be operated by electric motors, current being supplied by the power plant. This, when completed, will be the largest electric water works in the country.

NEW ENGLAND NOTES.

MR. A. L. FENTON will hereafter act as a general agent for the Perkins Electric Switch Mfg. Co., of Hartford, Conn., and it will be part of his special duties to travel through the East representing their well known specialties.

THE PETTINGELL-ANDREWS Co., of Boston, are at present getting out a new line of drop forged electric railway trolley equipment manufactured by the Billings & Spencer Co., of Hartford, the insulating compound for which is manufactured by the Colophite Manufacturing Co., of New Haven, Ct. The originator of this new overhead line material is Mr. Frank X. Cicott, manager of the railway department of the Pettingell-Andrews Co., who has for years been identified with railway work, and has consequently a large experience in this class of work.

THE HART & HEGEMAN MFG. Co. of Hartford, Ct., have just issued a new catalogue, which should be in the hands of all using this style of goods. It embraces switches of the well known Hart snap type, from 5 ampere single pole to 50 ampere double pole, with illustrations of all kinds of special three point, four point, and other switches. A full line of special flush plate switches are also illustrated, of every description, and varying size of plate according to number, the whole making a very handsome and useful catalogue to those interested in general electric construction.

THE JEWELL BELTING Co., of Hartford, Conn., are having an unprecedented success with their new Jewell pulley covering, which they have recently patented and which is intended for covering pulleys of iron, wood or other material, for the prevention of the slipping of belts. The cement is easily applied to any pulley, whether in service or not, and when once applied will last for years, and will give 25 per cent. more "grip" to belts than the ordinary pulley. Full instructions are issued for applying this material, and it is certainly worth the trouble of every engineer to satisfy himself of the claims of the Jewell Co., as the expense is by no means great, and the benefits are large.

THE EDDY ELECTRIC MANUFACTURING Co., of Windsor, Ct., have recently secured the contract for the electric light equipment of the new station of the New York Central R. R., at Syracuse, N. Y. The plant will consist of one 75 kilowatt and one 25 kilowatt direct connected Eddy slow speed generators, driven by Ball and Wood engines, and will be a model plant of its kind when completed. The Eddy Co. have a number of large contracts on hand for their multipolar type of generator and motor, and have some very interesting work on hand for special purposes, which we are not at liberty to describe, but for which they are exceptionally well equipped.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., report the sale, through their well-known Western contractor, Mr. J. Holt Gates, of Chicago, of two 65 K. W. new type direct connected generators for Fort Dearborn Building, Chicago,—these generators to be used in connection with Ball & Wood engines; also, the sale of two 50 K. W. direct connected generators to be used with McIntosh & Seymour engines for the Lauderdale Building, Providence, R. I., also, one 85 K. W. 220 volt generator to the Walter Ferris Coal Company, Salem, Ohio, and two 80 K. W. new type multipolar generators in the station of the Catasauqua Electric Light and Power Company, Catasauqua, Penn. These two generators are of the Mather Company's latest type, their speed not exceeding 800 revolutions per minute.

CANADIAN NOTES.

THE OTTAWA CAR COMPANY (Limited), of Kent and Slater streets, Ottawa, Canada, publish a handsomely illustrated catalogue of their electric street cars, sweepers, etc. They call particular attention to the fact that they are now in a position to furnish every style of car and complete equipments fully abreast of the times.

THE PROPOSED PACIFIC CABLE.

An analysis has been made by Mr. Sandford Fleming of tenders received for the construction of the proposed cable from Van Couver to New Zealand. For route No. 1, which seems to be the one which will have to be adopted in the event of arrangements falling through with Hawaii for a landing place on the Hawaiian archipelago, the lowest offer including maintenance for three years is £1,517,000. This is for a speed capacity of twelve words per minute. The route in question is entirely within British territory and would run from Vancouver Island to Fanning Island, Fiji, Norfolk Island, with branches from Norfolk Island to New Zealand and New South Wales.

For the adjustment of details, Mr. Fleming suggests that a joint commission be appointed to assemble in London, consisting of three commissioners—one for the imperial government, one to represent Canada, and one to act for Australia and New Zealand conjointly.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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THE IMPROVED BALL AUTOMATIC DYNAMO.

BY

Frank B. Widmayer

ONE of the favorite topics of controversy in electrical circles twelve or thirteen years ago was the unipolar dynamo designed by Mr. C. E. Ball and subsequently improved by Mr. R. E. Ball, and many of our readers will recall that it constituted one of the principal centres of attraction at the Philadelphia Electrical Exhibition in 1884. Many were the criticisms launched at this machine at the time, yet notwithstanding its non-conformity to the accepted canons of dynamo electric machine construction the Ball machine has not only held its own but has steadily increased in the extent of its commercial applications.

During all this time the original design of subjecting the armature to the induction of but a single pole piece has been steadily adhered to; but experience has gradually suggested improvements in the details of construction and it is believed that the latest type of the Ball machine contains features which may not prove without interest.

The distinguishing feature of the new machine is the regulator. Its action is dependent upon the well known principle that if a movable magnetic body be included within a magnetic circuit it will tend to adjust itself so that its axis of least magnetic resistance is parallel to the lines of magnetic force traversing such circuit and furthermore tends to take such position with a force proportioned to that of the magnetic flux. In applying this principle the brush holder or yoke becomes the movable magnetic body alluded to, entire freedom of movement being insured by its mounting on ball bearings, its form and construction being adapted to fit into a recess in the end frame and consequently within the direct magnetic circuit of the dynamo. The regulating force or impulse is thus obtained directly from the primary source of power without any intervening mechanism—no coils of wire, no wall-controllers to be actuated and no resistance to be overcome; it being simply an adaptation of the dynamo so that its parts may directly conjoin with one another to effect the desired equilibrium of action.

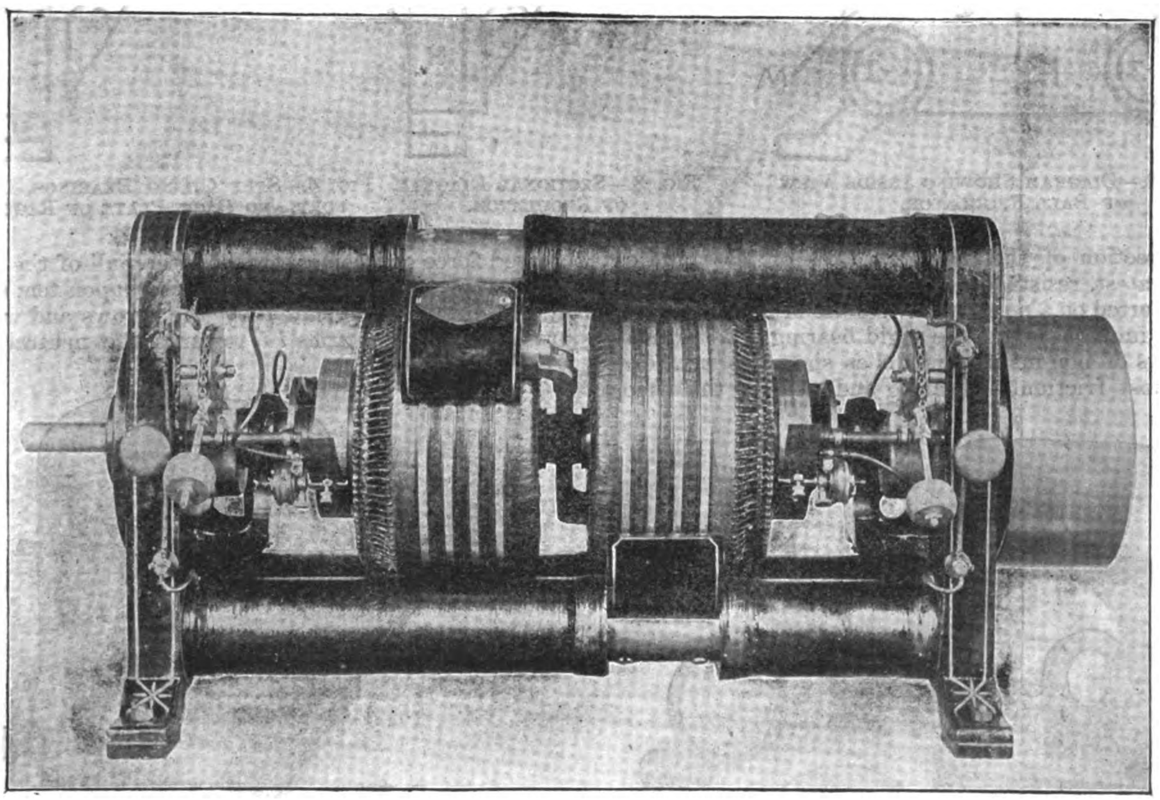


FIG. 1.—100 LIGHT 10 AMPERE 2,000 C. P. BALL AUTOMATIC DYNAMO.

Inasmuch as the Ball dynamo has two armatures the company now manufactures it with two automatic end frames, making it practically two machines, each wholly independent of the other, each, if necessary, capable of being used upon two circuits and each being self regulating and governing.

The engraving Fig. 1 shows the new type of Ball automatic dynamo complete with its two automatic end frames, self oiling bearings, etc Figs. 2 and 3 show the details of the movable magnetic body or regulator, the

former being a front view with the brass plate removed, revealing the interior construction and the latter being a cross-sectional view taken through the end frame and regulator at the dotted lines K K.

It will be noticed that the cast iron end frames H H are hollowed out leaving a cavity as shown, in which is placed the movable magnetic body A A. The lines K K, K K, are the direction of the magnetic axes of least, and C C, that of greatest, resistance. This moveable magnetic body A A is supported on a non-magnetic plate or hub B B which, in turn, is imposed upon the rigid bearing L L, by means of two rows of non-magnetic balls as shown at E E, forming an almost frictionless bearing and insuring the utmost freedom and ease of movement to A A. The magnetic stress actuating A A in the direction indicated by the arrows is counter-balanced by gravity, the adjustable weight N[1] operating to move the disc or cam N as shown. The other end of A A is fitted with a stop and dash-pot represented at P. Extension arms *i i* carry the holders for the brushes on to the commutator.

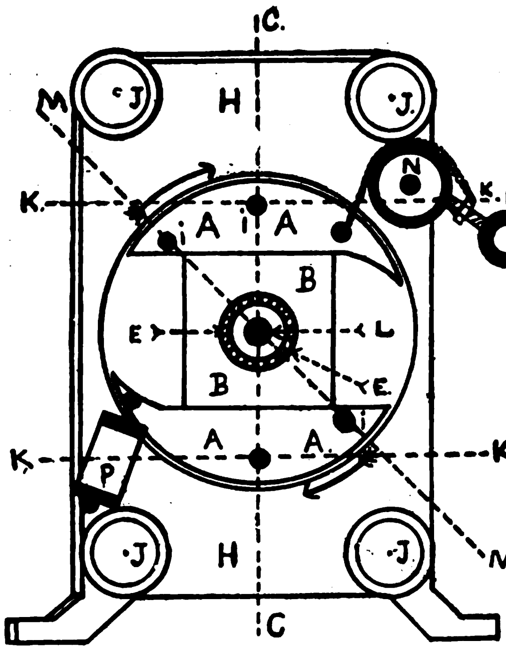


Fig. 2.—Diagram Showing Inside View of Ball Regulator.

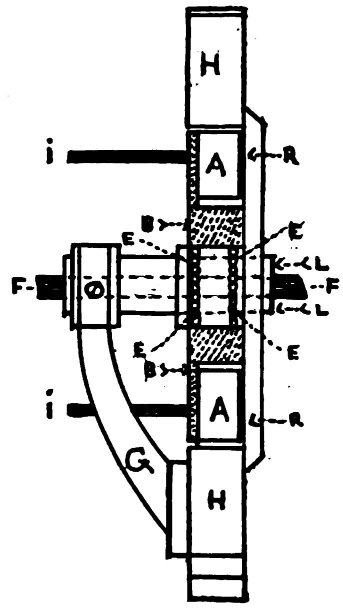


Fig. 3.—Sectional Diagram of Regulator.

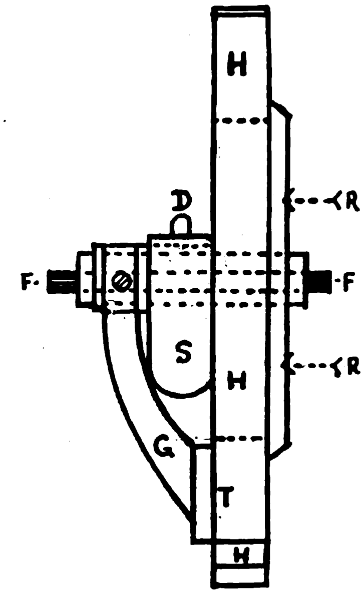


Fig. 4.—Self Oiling Bearings, Inner Support and Back Plate of Regulator.

When the magnetic plate or disc is in the position shown in Fig. 2 the brushes are upon the points of the commutator, represented by the line M M, and at position of full load or place of greatest potential, when the machine is generating its normal current and operating at its full capacity. When lamps are cut out the excess of current is thrown back upon the field coils thereby increasing their magnetic strength and the lines of force flowing through the end frame H and disc A A. This increased force overcomes the counter pull of the weighted arm N that acts upon A A, which thereupon tends to move in the direction indicated by the arrows and with it the brushes upon the arms *i i*, towards the neutral point or point of lowest potential on the commutator. The resulting diminution of the current of the external circuit necessarily diminishes the lines of force in the end frame, instantaneous repetitions of such reciprocating action immediately establishing the desired equilibrium. On the other hand when lights are added, the current falls, thereby lessening the magnetic force traversing the end

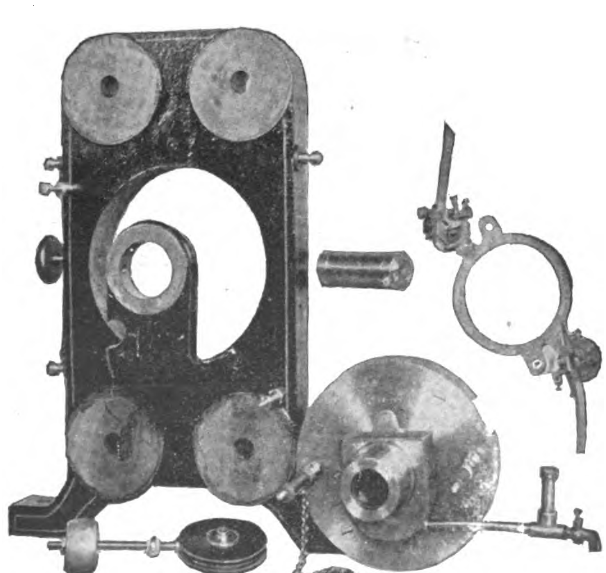


Fig. 5.—Parts of Regulator, Ready for Assembling.

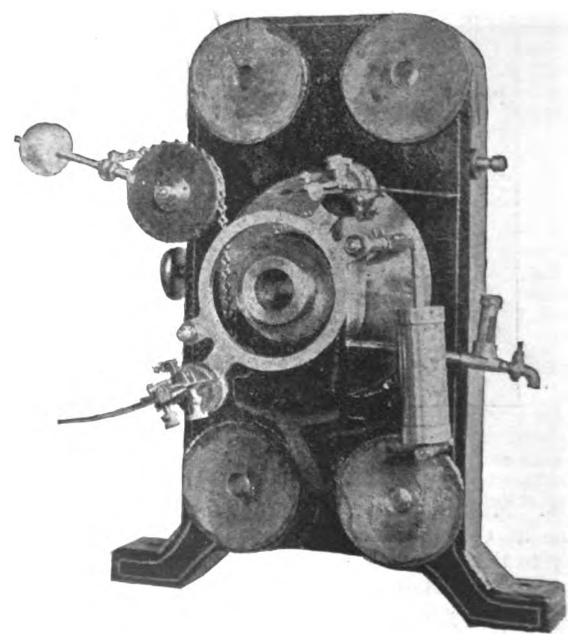


Fig. 6.—Automatic End Frame, Regulator Complete.

frame and disc A A so that gravity becomes the stronger, thrusting upwards A A and brushes to the point of highest potential upon the commutator, thereby increasing the flow of the field current to its normal, to which the diminished magnetism of the end frame adjusts itself, resulting in a reestablishment of the proper balance as before.

The regulation is absolutely automatic, an almost instanteous adjustment of the power required for the operation of a single to the full complement of lights being unfailingly effected. A 65-light automatic dynamo has been repeatedly short-circuited when equipped with these regulators invariably resulting in the immediate accomplishment of their function. A 100 light dynamo can be run for days without the least impairment of regulator or armatures. So speedy and so sensitive is this regulator that an adjustable dash-pot as shown at P is required to arrest its action, and even with this modification it is so responsive that the feeding of a single lamp in circuit will cause a movement of the brushes. The adjustment of the regulator to occasion an increase or diminution of the current is effected by an inward or outward movement

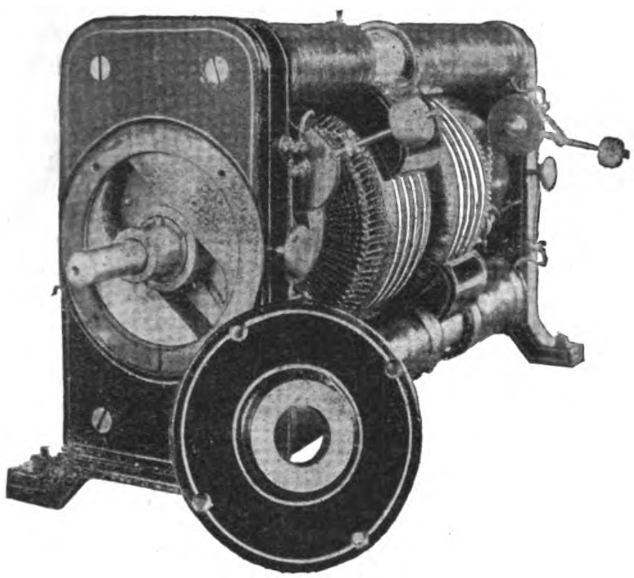


FIG. 7.—AUTOMATIC END FRAME REGULATOR WITH BACK PLATE REMOVED.

upon the threaded stem or arm of the adjustable weight or ball N.

In various other details the Ball Machine has been improved. Thus all dynamos from 15 horse power upwards are provided with a very simple self-oiling and self-aligning bearing and an inner support for the same, as shown in Fig. 4. This combination, regulator and bearing, is constructed so that it can be thoroughly inspected in a few minutes, the simple loosening of a couple of screws insuring the removal of the back plate E and also that of the entire bearing and regulator. The engravings, Figs. 5, 6 and 7 show the relative arrangement of the regulator parts on the end frames.

In coupling up the new Ball machines there are no loose wires or connections; all couplings are made by neat cables joined to well insulated binding-posts or studs which are mounted on the sides of the end frames. Fig. 1 shows these couplings upon a 100 light dynamo. The field coils are all wound on metal detachable spools which are thoroughly insulated by mica, and will withstand a pressure of 10,000 volts. In the large dynamos the field terminals are connected with a short circuiting switch; the armatures are insulated with silk and mica and their construction and mounting is such that it is wellnigh impossible for any part of their windings to become grounded with the core, or with the dynamo shaft and frame.

ELECTRIC LIGHTING STATISTICS.

BY I. C. WOOD.

THERE has been a demand of considerable magnitude for comparative statistics showing the cost of electric lighting under various conditions. The major portion of this demand comes from officials in cities and towns that have evinced a disposition to break away from a real or imaginary oppression that is said to be practised by private corporations. In response to this demand a mass of misinformation, consisting of undigested reports and guesses as to real cost of operating, maintaining, and renewing the plants has made its appearance.

In 1894 three sets of figures were published which purported to give the data that city officials were seeking, and it is these reports that will be analyzed in this article. In May 1894 W. J. Buckley published his book "Electric Lighting Plants." On pages 352-3-4-5 of that work are tables giving (1) Reports of Cities Owning and Operating their Own Electric Lighting Plants, and (2) Reports of Cities Lighted by Private Contract. There are 52 of the former reports, and 92 of the latter. In November 1894 a

TABLE I.

Private Plants.

	Population.		Cost per lamp per year.		Schedule.	
	Buckley.	Real Estate Paper.	Buckley.	Real Estate Paper.	Buckley	Real Estate. Paper.
Allentown, Pa........	25,000	25,000	$100.00	$100.00	All night.	All night.
Auburn, N. Y..........	26,000	26,000	87.50	87 50	"	"
Birmingham, Ala......	26,100	26,000	96.00	96.00	"	"
Chattanooga, Tenn....	30,000	29,000	96 00	96.00	"	"
Houston, Texas........	30,000	27,500	150.00	150.00	"	"
Joliet, Ill..............	25,000	23,000	100 00	100.00	"	"
Kalamazoo, Mich	17,800	24,000	172.00	170 50	"	"
Leavenworth, Kan....	19,000	19,000	96.00	96.00	"	"
Montgomery, Ala.....	21,800	22,000	90 00	90.00	"	"
Newport, Ky........ ..	25,000	25,000	100 00	100.00	Moonlight.	"
Pueblo, Col............	24,000	24,000	182 00	182.00	All night.	"
Racine, Wis............	21,000	21,000	80.00	80.00	"	"
Roanoke, Va...........	25,000	25,000	87.60	87.60	Not given.	"
South Bend, Ind.......	21,800	22,000	100.00	100.00	All night.	"
Springfield, Ill....	25,000	25,000	137.00	137.00	Moonlight	"
Springfield, Mo........	22 000	22,000	114 00	114.00	All night.	"
Waterbury, Conn......	24,000	24,000	121.00	121.00	"	"
Wichita, Kan..........	24,000	24,000	108.00	108.00	"	"
Average all night schedule..				109.81		

Municipal Plants.

Alexandria, Va........	14,880	14,000	$55.00	55 00	None given.	None given.
Anderson, Ind...	10,700	11,000	40.00	40 00	"	"
Ashtabula, O..........	8,300	8,000	77.00	77.00	"	"
Aurora, Ill............	20,000	20,000	58 40	58.40	"	"
Bay City, Mich........	27,800	28,000	49 70	49.70	"	"
Bloomington, Ill.......	20,400	20,400	51.60	51.60	"	"
Decatur, Ill...........	17,000	17,000	50 00	50.00	"	"
Dunkirk, N. Y....	10,000	10,000	41.43	41.43	"	"
Easton, Pa....	15,000	15,000	82.40	82.40	"	"
Elgin, Ill................	20,000	20,000	62.00	62.00	"	"
Frederick, Md........	8,100	8,000	60 00	60.00	"	"
Hannibal, Mo.........	12,800	13,000	50.00	50.00	"	"
Jamestown, N. Y......	18,000	18,000	44.00	44.00	"	"
Lewiston, Me....	21,700	22,000	55.00	55 00	"	"
Little Rock, Ark......	25,800	25,000	70 00	70.00	"	"
Madison, Ind....	8,800	9,000	58.00	58.00	"	"
Marquette, Mich	9,000	9,000	60.00	60.00	"	"
Portsmouth, O........	12,300	12,000	38 50	38.50	"	"
Titusville, Pa	8,000	8,000	47.00	47.00	"	"
West Troy, N. Y.......	12.900	13.000	60 00	60.00	"	"
Average.................				$55.50		

monthly real estate paper, published in St. Paul, Minn., printed figures which very closely follow those in "Electric Lighting Plants," except that only reports of those cities having populations of not more than 30,000 (in all out of the 114), were used. An average of the cities in each list was struck, showing a cost per lamp per year for Municipal Plants, of $55.50, and for Private Plants, $109.31.

Mr. Buckley, in printing his figures in May 1894, distinctly stated that in most of the reports from municipal plants, there was neither interest on cost of plant, nor depreciation of the plant, included. As these two items represent an average annual outlay of 13 per cent. of the total cost of the plant, any tables that do not include them, cannot convey an accurate idea of the annual cost per year

per lamp. But the real estate paper, in printing its tables, made no mention whatever of this absence of important factors in its figures, nor was any source of its statistics given.

A careful comparison of the tables printed in May, and those given in November, shows only the slightest variation in them, and in order to show this more clearly, we give them above, side by side, Table I.

The conclusions of the real estate paper were sufficiently catchy to attract the eye of a populist paper, which faithfully copied them. The *Public Opinion* copied them from the populist, and so started them on the rounds. Among the papers that afterwards printed the figures was the Springfield, (Mass.) *Republican*, and it commented upon the averages as follows: "Unfortunately the paper in question (meaning the real estate paper) has nothing to say of how the figures were obtained, or whether all the elements of the problem are fairly and equally represented in each case. Do the municipal lighting figures cover all the cost of the business?" The *Republican's* comment is the same that occurs to every practical man, and without the answer the figures are worse than useless—they are vicious. A city that is contemplating the erection or purchase of a plant ought to have all the elements of cost before it.

Desiring to follow the subject to its logical end, that the truth may be known if possible, or if not possible, that the danger of drawing conclusions from unreliable data be made plain, we have gone into the matter somewhat extensively. Unreliable figures are the plague of the practical man, and if he base calculations upon them he will be worried and disappointed at the results. Fortunately, in this instance, figures are obtainable, either corroborating or refuting those given above. Mr. Buckley, whose May figures so singularly coincide closely with those printed in November, states positively that a majority of the Municipal Reports do not include "interest and depreciation."

Mr. Horatio A. Foster, who is known to many city officials as an expert electrician, published an article in THE ELECTRICAL ENGINEER of September 5, 1894, giving the results of a six months enquiry into the "Cost of Public Lighting by Municipal Plants," in which he gives details of the minutest character. Mr. Foster, also, found in most of the reports he received that interest and depreciation had not been computed. In all cases where this had not been done, Mr. Foster added a sum equivalent to 5 or 6 per cent. on the cost of the plant, as interest, and 7½ per cent. to cover the annual depreciation of the works.

In Mr. Foster's reports of 49 cities are 10 that appear in Table I.; hence we have, in his independent and expert

TABLE II.

	Total Cost of Plant.	Arc Lamps Used.	Operating Expenses Reported.	Add for Interest and Depreciation.	Total Annual Cost.	Cost per Lamp per Annum.	
						Foster Basis.	Real Estate Paper Figures.
Anderson, Ind....... ..	$87,550	150	$5,181	$3,719	$8,900	$59	$40
Aurora, Ill.............	45,828	179	10,081	6,118	16,199	90	58
Bay City, Mich.... ...	85,963	181	8,978	4,486	13,464	74	49
Dunkirk, N. Y.........	19,866	75	3,504	2,483	5,987	79	41
Elgin, Ill...............	24,000	98	6,815	3,000	9,815	100	62
Frederick, Md.........	15 000	65	3.500	2,025	5,525	85	60
Hannibal, Mo..........	46,981	100	6.901	5,123	12,024	120	50
Little Rock, Ark.......	39,739	132	9,050	5,364	14,415	109	70
Lewiston, Me...........	16,000	100	5,000	2,160	7.160	71	55
West Troy, N. Y......	26,000	103	6,296	3,510	9,806	95	60

investigation, a means of confirming or disproving the conclusions which were so noticeably drawn by the real estate paper. We, therefore, give the following figures, Table II., taken from the Foster article, and add the two last columns. No further comment need be made on the two sets of figures which in Table I. purport to give "Cost per year per lamp" than to point to the two last columns in Table II. The column headed "Foster basis" is made up by dividing the total cost by the number of lamps reported in use.

As an actual test of real cost of electric lighting, none of the above figures, in either table, afford a sufficiently accurate basis. To illustrate this let us take two instances of different conditions under which lighting is obtained. South Norwalk, Conn., has a municipal lighting plant which is considered an honest specimen of what may be done under public ownership. From the official report recently issued the following data is taken. During the year ending October 12, 1894, it burned an average of 98 arc-lights, having an average capacity per lamp of 1400 candle-power, and being lighted 309 nights during the year. That is to say, each lamp gave a light equal to 1400 candle-power 309 nights, or (1400 x 309) 433,300 candle-power during the entire year. The report does not state how many hours each light burned during the year, but it does state that the lights are started at dusk and stopped at 1.30 or 2 a. m. On cloudless nights the lamps are not lighted.

This gives us, then, a light lasting, say, an average of 8 hours per night for 309 nights, or 2472 hours of actual lighting during the year, for each lamp. The report places the average cost per lamp per year at a few cents less than $60.

Buffalo, N. Y., pays a private company 35 cents per night for an all-night, 2000 candle-power light, the year round, or 365 nights. In 1894 each lamp burned 4066 hours. The total cost per lamp (365 x 35) per annum, (not counting deductions for outages) is $127.75. Thus Buffalo gets 2000 candle-power for 365 nights, a total of 733,000 candle-power per lamp per annum, and pays $127.75 for 4066 hours of 730,000 candle power light.

Summarizing, we find therefore:

	Cost per lamp per hour.	Hours light furnished.	Candle power of light furnished, per lamp.	Total candle power light used.	Cost per candle power.
Buffalo, N. Y.......	$127.75	4066	2000	730,000	.0175 cents.
South Norwalk.....	$60	2472	1400	433,000	.0138 "

And even this comparison is not an absolute basis, but it brings the two nearer to a common standard than is possible by merely stating cost per lamp, regardless of amount of work done by the lamp.

As a matter of indisputable fact, Buffalo pays $127.75 per year for a lamp, while South Norwalk pays less than half that amount; but Buffalo gets *almost twice as much light*. Now comes the question, Would the light which South Norwalk receives, be sufficient to satisfy Buffalo, even if the latter could have it at the lower price, and if not, is the excess of light which Buffalo gets costing that city more than the same excess of light would cost South Norwalk if the latter were to increase output, plant and equipment to a point where it could furnish a supply of light equal to that necessary to satisfy Buffalo?

ARC LIGHT DUCK SHOOTING.

The officers of the steamer Nutmeg State, plying between Bridgeport, Conn. and New York, had a fine dinner of wild duck recently. When the steamer left Bridgeport at midnight a flock of ducks hovered around the boat. When off Penfield Reef ice was found floating in the Sound in large quantities, and the search light was turned on. A short time afterward Capt. Wilcox heard a great flapping of wings, and by the rays of the powerful light saw a large flock of ducks circle again and again around the boat. Suddenly they turned and darted straight toward the light. They struck the thick glass of the search light and the iron box surrounding it, the pilot house and the smoke stack. When the excitement was over it was found that fully a score of the birds had been killed.

ELECTRIC TRANSPORTATION DEPARTMENT.

A PERFECT RAIL BOND.

BY

Harold P. Brown.

In the large railway power houses that have been built during the past year or two, every resource of engineering skill has been called upon to secure economy of power. The best types of boilers, of feed-water heaters and fuel-economizers are used; the engines are compound and when possible condensing; the dynamos are direct-driven and a high ratio is maintained between the hourly coal consumption and the average electrical output. Yet the result in pounds of coal per car mile is far from satisfactory. The motors are not to blame and the popular series parallel control has diminished the former rheostat waste in starting and slow running. The fault evidently lies in heavy transmission losses and yet we are frequently told that the drop of pressure is only 10 per cent. Unfortunately this is not the case for we again and again find 400 volts at the motor while the dynamos are at 550, or 27 per cent. drop; and practical electric railway men are beginning to realize that this means a transmission loss of 47 per cent. Such losses are encountered almost every day by even the best roads and are usually the result of bad bonding.

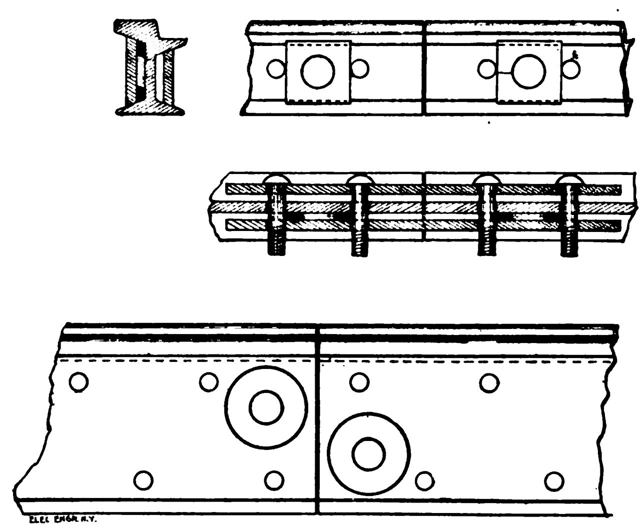
In an electric lighting system the drop in pressure between dynamos and incandescent lamps indicates the total loss in transmission, but in an electric railway line the drop is only a portion of the total loss. When a drop of pressure is encountered at the terminals of an incandescent lamp, its current diminishes, its resistance rises and it therefore absorbs less energy. In this case a 10 per cent. drop means a 10 per cent. total loss in conductors. A railway motor with the same drop will at once lower its speed and will therefore require a corresponding increase of current to do the same work. Hence the supreme importance of perfect bonding, for the pressure cannot be maintained if there is a heavy loss at every rail joint.

Very few electricians have suspected that there is in all copper bonding of steel rails, a loss which does not depend upon the cross section, the contact area nor the mechanical perfection of joint. Modern practice in rail bonding ordinarily calls for a generous amount of copper with a rail contact area 7 to 10 times its cross section and with heavy bolts, nuts or wedges to hold the two metals together. When such a joint is covered with a viscous paint it would seem to be mechanically and electrically perfect. But careful measurements of the drop in these joints even when new and at their best, give startling results with heavy currents. The thermo-electric difference between steel and copper evidently causes a loss many times that due to the resistance of the copper alone. But when this joint has been submitted for even a few months to the acidulous moisture of a city street and to the mechanical changes encountered in service, the loss grows rapidly greater. Only a short time is required to deposit a slight film of iron rust between the surface of rail and bond; this film is of high resistance and serves as a channel for the admission of more and more moisture and the conductivity decreases rapidly. Every passing car and each change in current aids in the work of destruction.

For several years experiments have been in progress at the Edison laboratory, with its magnificent equipment for investigation, to obtain a permanent rail bond of low resistance, which would encounter no thermo-electric loss, would make an absolute contact and would be proof against rust and against mechanical injury from the hammering of wheels and the changes of temperature and variations of current. Hundreds of promising schemes were tried and found wanting. As has been stated elsewhere, every practical combination of metals, every method of joining, of excluding moisture, of providing for expansion and contraction, has been tested with heavy currents and then buried for the test of time. The contact surfaces have even been welded together, have been machined and scraped to an exact fit, bolted together with heavy pressure, plated with tin or copper, provided with sheet lead, tin foil or other soft metal or with various non-rusting alloys placed under compression, covered heavily with paint or other water-repelling insulation or a combination of several of these. But only a single one of these has successfully withstood the test of time and has proved to be a perfect rail bond. After a test of about four years on covered rails, it shows no increase of drop and will carry 1,500 amperes. A large number of these joints have recently been dug up for examination and show no trace of rust on the contact surfaces.

In its present form the "Plastic" rail bond as it is called is composed of two portions; a plastic metal compound which makes an absolute contact between the rail and the fish plate, and a case to hold it in position between the bolt holes as near the end of the rail as possible. No holes in the rails are needed nor any wires, plates, bolts, nuts nor rods, and the completed joint is perfectly protected by the fish plate. For different types of rails cases of various shapes are used. For heavy girder rails the case is a flat ring of specially moulded cork, 3⅞ inches outside and 1½ inches inside diameter and ⅝ inches thick. It is treated with a viscous insulating compound which will not oxidize or crack. With a hooked-shaped scraper or a small emery wheel the scale is removed from the surfaces on rail and fish plate where the cases are to be placed. The centre of each of these surfaces is rubbed with a special alloy, discovered by Mr. Edison, which instantly changes any iron rust to pure metallic iron and forms a silver-like deposit which repels water and will not corrode. See Figs. 1, 2, 3 and 4.

A permanent iron amalgam which has been considered a chemical impossibility, is thus produced upon the surfaces and in this lies the cause of the low resistance and durability of the joint. One side of the case is then slightly warmed and thus made viscous, and placed upon the prepared surface of the web of the rail. As soon as it sticks, a plug of the plastic metal, surrounded by a steel spring, is put into the hole which slants downwards towards the base of the rail so as to retain the free liquid metal in the compound. A second case and plug are similarly placed on the adjoining rail and the fish plate bolted down. The tightening of the bolts compresses the cork to half its former



FIGS. 1, 2, 3 AND 4.—THE EDISON PLASTIC RAIL BOND.

thickness and makes its surfaces stick firmly to the steel, the spring forming a distance piece to prevent too much compression. The fish plate nuts are locked in position, but even if they should slacken and the plate drop back ¼ of an inch, the cork will expand or be pulled out to its former thickness by the adhesion of the insulating compound to the steel, and the plastic metal, by gravity and the expansion of the spring, will maintain a perfect electrical contact. In fact it is hardly accurate to call this junction a "contact" since the affinity is so great between the prepared surfaces of the steel and the metal of the bond, that it is difficult to separate them; and the conductivity of the joint is practically equal to that of the rail itself.

The plastic metal cannot be injured by the blows of passing wheels. It is sealed from air and water and will remain plastic indefinitely if properly applied. The elasticity of the cork permits the movement of the rail and fish plate due to temperature expansion and contraction. Even though water or any acid or alkali likely to be encountered in the streets, should get to the plastic metal it cannot affect it nor corrode under the prepared surface of the steel, into which the amalgam seems to penetrate.

The remarkable conductivity of the joint and its low drop is shown by the tables below. For cross-bonding or feeder wire connections a third bond is placed on the rail near the end of the fish plate and is clamped upon a tinned strip of sheet copper which projects beyond the plate far enough to be soldered to the wire. As this bond has a conductivity equal to the rail itself, a large reduction in feeder wire can be made by its use. It is cheaper

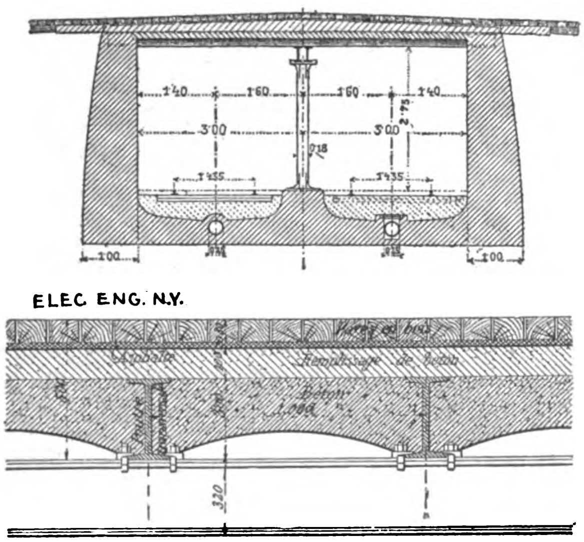
than copper of half its carrying capacity and will last as long as the fish plate. The saving of motive power from its use may be calculated from the following tables of measurements made at the Edison laboratory in the presence of a number of prominent

Amperes.	Copper Bond ⅝ inch diameter with best mechanical contact of 10 times its cross section; surfaces bright. Volts Drop.	Drop of same due to copper resistance only. Volts Drop.	90 lb. Girder Rail joint with Plastic Rail Bond. Volts Drop.	Same with fish plate loosened ¼ inch. Volts Drop.	60 lb. T-Rail joint with Plastic Rail Bond. Volts Drop.	Amperes.
50	0.05	0.0025	0.0025	0.0025	......	50
100	0.08	0.005	0.005	0.005	... .	100
200	0.15	0.01	0.01	0.01	......	200
300	0.215	0.0175	0.0125	0.0125	0.0167	300
400	0.27	0.0225	0.02	0.02	0.025	400
500	0.315	0.03	0.0225	0.0225	0.034	500
600	0.35	0.035	0.03	0.03	0.037	600
700	0.38	0.04	0 035	0.035	0.041	700
800	0.41	0.0475	0.04	0.04	0.05	800
900	0.45	0.05	0.045	0.045	0.067	900
1,000	0.455	0.06	0.0475	0.0475	0.075	1,000
1,100	0.46	0 065	0.05	0.05	0.088	1,100
1,200	0.47	0.07	0.06	0.06	0.091	1,200
1,300	0.49	0 0665	0.0625	0.0625	0.098	1,300
1,400	0.50	0.0825	0.065	0.065	0.106	1,400
1,500	0.515	0.09	0.07	0.07	0.114	1,500

electric railway engineers. The copper bond tested had the most perfect mechanical contact that could be devised and was perfectly bright and clean. The Weston instruments used had just been calibrated and the readings were made by the visitors.

THE BUDAPEST UNDERGROUND ELECTRIC RAILWAY.

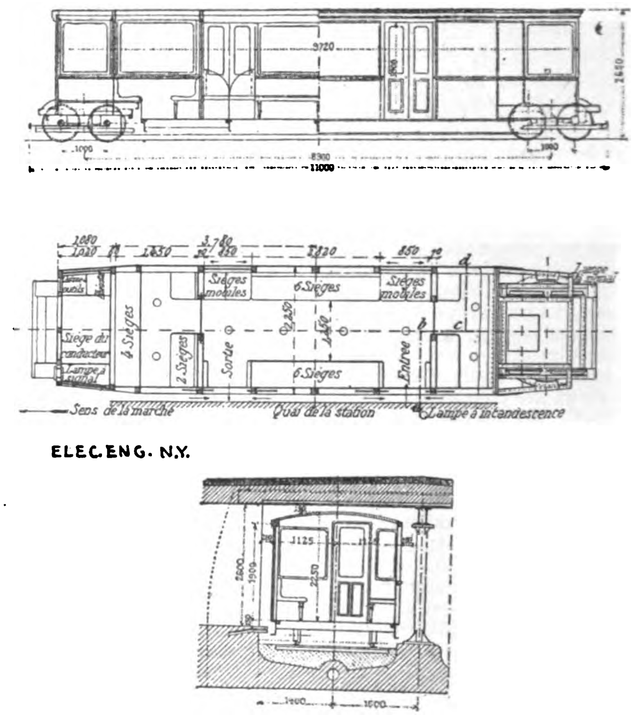
As already announced by us, the franchise for the construction of the Budapest, Hungary, underground railway was granted on the 9th of August, 1894, and work is now actively progressing. This road is not constructed after the manner of the electric railway tunnels in London, but runs under the streets with a roof placed immediately under the paving stones of the streets. The line is entirely underground within the city limits and only reaches the open air at the terminals, one of which is situated in an adjoining city park. The total length of the line is 2½ miles, of which 2 are underground. There are 11 stations on the line, the distance between which varies between 207 and 450 yards. The height of the tunnel above the rail is 9 feet which was limited to that altitude by the large sewer which is



FIGS. 1 AND 2.

crossed by the line. The construction is illustrated in the engraving, Fig. 1, which shows a cross section of the tunnel, the dimensions being given in millimeters. In order to lessen as much as possible the thickness of the roof, a line of columns has been placed between the two tracks, so as to avoid the necessity of arching. The distance between the cars and the sides of the tunnel is 11 inches; between the cars and the columns 15 inches. The total width of the tunnel is 19 ft. 6 in.

The construction of the roof is shown in detail in Fig. 2, which gives a longitudinal section. The roof is constructed by simply filling in between the beams with beton concrete. Above this there is run a beton less rich in cement; this upper layer has a thickness of 4 inches. Finally, on this layer is placed sheets of felt soaked in asphalt; over this is spread a layer of sand on which the paving is laid. The engravings, Figs. 3, 4 and 5, show longitudinal and transverse views of the car, the dimensions of which are indicated



FIGS. 3, 4 AND 5.

on the drawings in millimeters. The car itself is divided into three compartments. That in the centre is the largest, and is directly accessible from the station platforms, whereas the two end compartments can only be reached by passing through the centre. These small end compartments are designed for non-smokers and ladies. They have each a length of 4 ft. 9 in. and room for 7 seats. The large compartment in the centre is reserved for smokers. There are two doors, one for entering and the other for exit. The total seating capacity is 30, with room for 12 standing in the aisles.

The ventilation of the cars will be done by means of fans placed one in each of the three compartments and operated by electricity. These fans will not operate while the cars are running in the tunnel, but when the cars stop at the stations where the air is good, they will start up automatically and stop in the same way when the car starts again. The stations will be indicated by automatic signs. The motors will be connected to the axles by single reduction gear, each car being provided at the ends with a compartment for the motorman, who will be so situated that he can, without difficulty, see the motor below him in operation, and thus constantly have it under observation.

HOW SHALL THE TROLLEY BE APPLIED ON STEAM ROADS?

To the communications already printed on this subject we add below a number, beginning with that of Mr. T. C. Frenyear, of the Cayadutta (N. Y.) Electric Railroad, which parallels the Fonda, Johnstown & Gloversville Street Railroad (steam), and by which it was leased shortly after its completion. The Cayadutta electric road now does all the passenger business, while the old steam road is confined to freight traffic exclusively.

I have been much interested in your editorial and the discussion following, touching the application of electric motive power to steam railroads, having had some experience in the construction and operation of an electric line under usual steam railroad conditions and paralleling a steam line. The experience has suggested some considerations applicable to enterprises of this kind.

1. The advantages of present electric railway practice must not be sacrificed, at least until other greater advantages can be ensured. Among those advantages are frequency of service and the utilizing of the weight of car and passengers for traction, both of which are secured by motor cars and would be sacrificed by the use of electric locomotives. The great advantage we have had over the steam road connecting the same towns is the ability

to operate a much greater number of train units for a given cost. Our motor car mile expense has been about one-sixth the train mile expense on the other road.

We have found the motor cars especially designed for our road to be just the thing for the service, combining, as they do, all the facilities of a train, baggage room, smoking room and ladies' compartment, and being large enough to accommodate the ordinary travel without trailers. These cars are 36 feet long and 8 feet wide, and provided with double trucks with 33 inch drivers. An interurban line approximating steam railroad passenger business, should never use a four-wheel car. The cars above described are equipped with two 30 H. P. motors, but they should be two 50 H. P. instead, and wound for high speed; then on a properly constructed line there is nothing to prevent a speed of 40 miles an hour, and trailers can be handled when needed.

2. The stations for receiving and letting off passengers should be frequent. A building is not always necessary, but whether advisable or not must be determined by local conditions. Cars should not stop except at principal stations, unless signalled.

3. For a line having several different rates of fare we have found the duplex ticket system for all cash fares the best.

4. The car wheels and track should correspond to steam railroad rather than street railroad practice. We use wheels with 3½ inch tread and ⅞ inch flange. Our turnouts are side turnouts with split rail target switches and very long leads.

5. It is perfectly feasible to operate a 12-mile section from one power house and use the ordinary 500 volt continuous current system. I see nothing to prevent the use of a higher voltage, up to 1,000 volts for a line not operating on city streets, and the use of the alternating current is bound to come; but for the present the limits of the 500 volt continuous current have by no means been reached, and the choice lies between that system pure and simple, the three-wire modification of it, and the use of the "boosters" in connection with it; and I should use a very large amount of copper rather than adopt either of the last two methods, except under unusually favorable conditions. T. C. FRENYEAR.

RAILBONDING AND ITS BEARING ON ELECTROLYTIC ACTION.

UNDER the above heading Mr. George P. Low contributes an interesting communication to the February *Transactions* of the American Institute of Electrical Engineers, as a part of the discussion on Mr. I. H. Farnham's paper read before the Institute last year.

The author gives a number of striking examples of electrolytic corrosion, and shows the conditions under which destructive electrolysis takes place. He concludes that electrolysis will not occur when the following requirements have been complied with:

1. No cross-bonding at points where the mains show permanently negative potentials.
2. Heavy cross-bonding at points where the mains show permanently positive potentials.
3. Rail bonds of absolute permanence and reliability.
4. High conductivity in track return circuit.
5. Greatest possible resistance from tracks and mains, at points where the mains show permanently negative potentials.

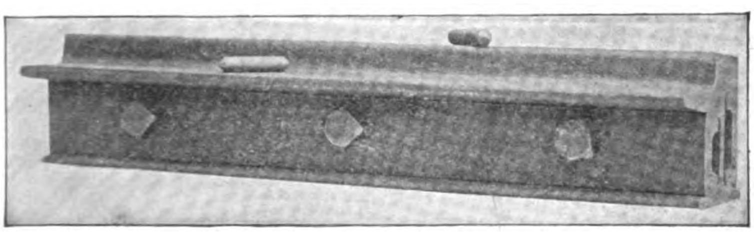


FIG. 1.

6. Generators to permanently feed positive to line and negative to track and main.
7. Heavy bonding between the negative side of generators to various proper points of mains not heretofore designated.

As a means of obtaining the best return circuit the author describes the "direct bonding" of Mr. F. T. Newberry. The bond consists merely of a copper dowel that is shrunken-fit into holes drilled into the abutting rail ends. The bond is formed by reaming out holes in the ends of the rails to be coupled, one in the head and one or more in the bottom flange, as shown in Figs. 1 and 2. For a 70-pound rail the preferred diameter of the holes is $\frac{5}{16}$ in. These holes are to be bored just before placing the rail, which is then heated by a gasoline torch and a round bolt or dowel of pure soft copper, two inches long and slightly larger than $\frac{5}{16}$ in. in diameter is driven in one rail. Then the abutting rail is forced upon the other end of the dowel, the faces of the rails being brought as closely together as possible. The fish-plates are then placed and double-bolted, riveted or welded together. The carrying capacity of these two dowels would be equal to one-half that of the rail, or equal to a bar of copper ½ in. wide by 1¼ in. thick, which is amply sufficient to carry the return current of any road now in operation in this country. If it were found advisable to double this capacity, it would be done with three dowels, one of ⅞ in. in diameter in the head, and two of ⅝ in. in diameter in the bottom flange. The junction of the copper and steel in the interior of the rail is electrically perfect, and remains so as long as the rail continues in place. When the work is well done, no particle of copper will be exposed to any action from air, water or other agencies, and being completely enveloped in the rail will be perfectly protected from fracture or harm of any kind.

The connecting surface of this bond is seven times its area,

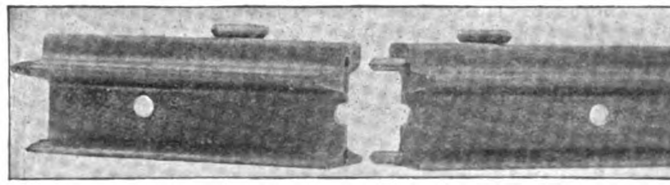


FIG. 2.

thereby affording the rail a carrying capacity at the point of bonding equal to that of the bond itself, and with rails 30 feet long, 352 joints per mile, 70 pounds of copper will be consumed in bonding a single-track mile. Experience proves that no great heating of the rail is required to effect an immovable grip on the copper dowel, which is polished and placed in the freshly bored hole in the rail end that has been heated at so low a temperature that there is not the slightest oxidation. Additional rigidity is secured by rendering the dowel ends slightly conical, so that they are upset in being driven home.

ELECTRIC VS. STEAM LOCOMOTIVES.

BY WILLIAM BAXTER, JR.

The able editorial on Locomotive Building in THE ELECTRICAL ENGINEER of March 13th, contains statements of facts, that will cause every one who reads it to realize that the electric railway motor has forced its way into use at a much faster rate than its most sanguine friends ever expected. No engineer of any prominence would have been willing to say, three or four years ago, that at the present time the electric motor would be making such inroads into the legitimate field of the steam locomotive as it really is making, to-day.

The main reason why the ability of electricity to compete with steam has alway been underestimated is that about the only direction in which competition was considered possible was in coal consumption. But railroad men, whether engaged in operating steam or electric roads, know that the coal bill is only one of the items in the cost of operation, and that it does not constitute such a large portion of the total expenditure as to make it possible for even a very great reduction in this direction to determine the superiority of one system over the other. If, then, the slight saving in coal consumption is not enough of itself to enable electric motors to supersede steam locomotives, what are the other advantages in virtue of which the former are forging to the front at such a surprising rate? These advantages cannot be so stated as to show clearly their importance without going into a lengthy discussion covering the entire subject of electric railway operation; but briefly they may be summarized as follows:

FIRST: The cost of repairs is less with electric motors than with locomotives, because the mechanism is far more simple. There are not so many moving parts, and these parts are not so much exposed to the action of mud, sand, water, etc. It would not have been safe to make the above statement three or four years ago when railway motors were in so crude a state that the cost of repairs was a very formidable item, but at the present time, those experienced in the construction of railway machinery are able to, and do, make motors that require little or no repairs, outside of the occasional renewing of journal boxes.

SECOND: The miles run per day, or in other words, the hours of service obtained per day, are greater with railway motors than with locomotives. On this account, the cost of labor, per mile run is much less and the amount of work done with a given sum invested in motors is greater than with locomotives. Locomotives running at an average speed of thirty or forty miles per hour do not make any more miles per day than motor cars, which only average about one third these speeds. When electric motors of larger size and for higher speed than those now used

are made, to take the place of locomotives, they will be run about the same number of hours as the motor now in use, and will therefore cover from two and a half to three times the distance now covered by locomotives. It may be asked: Why cannot locomotives be run just as many hours as motors? Simply because they have to be run in to the round house, and be thoroughly examined and cleaned up to be ready for the next day's run; they could not stand the treatment that motors are subjected to.

THIRD. The motors used to draw a train can be placed under one of the cars. This will reduce the weight of train and therefore the power required to move the same. As the weight of train would be reduced, and as all the weight of motor car, including passengers or freight could be placed on the driving wheels, it would not be necessary to make the motor car as heavy as a locomotive to do the same work; therefore from this source there would be a further saving in power. There will be less weight carried on any one pair of wheels and this weight will be more thoroughly spring supported. Therefore the track will be subjected to less strain and require less repairs.

The foregoing are a few of the advantages briefly stated that will enable electric motors to compete successfully with locomotives. I will not go into the subject any further here, as nothing short of an exhaustive treatment of the whole question would show the position that the electric railway motor is destined to take in the future. I have no doubt whatever that the various branch lines that are now being equipped electrically by several trunk lines will prove thoroughly successful, and that they are the entering wedge that will open up a field for railway motors of proportions too great to be estimated at the present time.

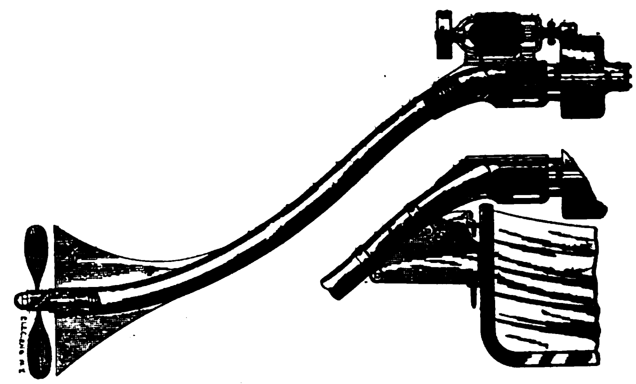
THE ELECTRIC BOAT COMPANY'S PROPELLER.

There is now on exhibition at the Grand Central Palace, 43rd street and Lexington avenue, an interesting and ingenious electric boat propeller, which is being introduced by the Electric Boat Company, whose New York office is at 186 Liberty street. The device is the invention of Mr. W. S. Salsbury, of Chicago, and is shown in detail in Figs. 1 and 2. As will be seen, it consists of a motor and propeller-wheel supported upon a movable tube, flexibly connected with each other, the tube having an attachment for connecting it to various forms of boats in precisely the same manner and with the same ease that a rudder is shipped. This produces a combined propelling and steering mechanism, entirely taking the place and doing away with any form of rudder for steering purposes, and is therefore entirely independent of a rudder in its functions of propulsion.

Fig. 1 shows a side elevation of the apparatus. Within the tube is seen the flexible shaft made of three coils of phosphor bronze. The motor and gear casing are mounted on the tube, inward, and their weight counterbalances that of the propeller. Fig. 2 shows one way of mounting the propeller on the stern of the boat. It is claimed that by means of the flexibility of the shaft, all jerking or vibratory motion is taken up, thus insuring easy running, and also a higher rate of speed, with maximum current rate of discharge, owing to the spring action in the line of rotation.

When the circuit is closed, in starting, the spring action of the shaft also enables the motor to get up its counter-electromotive force more speedily and with less danger of overheating the armature. The use of the tubing partially filled with oil and enclosing the flexible shaft admits of constant and copious lubrication of the shaft and journal bearings, reducing the friction and wear to a minimum, and prevents the access of dirt to the working parts. The spring of the flexible shaft relieves the motor and propeller-wheel of any sudden strain due to rapid starting or stopping of the motor. Another important feature is that the thrust of the wheel is borne by the tube, thus relieving the motor from the thrust of the screw-wheel when in motion.

The weight of the motor and propeller combined is only 35 pounds and the weight of the batteries ranges from 75 to 275 pounds according to kind and quality.



FIGS. 1 AND 2.

Fig. 3 shows the device attached to a boat in actual use. Its extreme portability should recommend it especially to hunters and tourists in the mountain lake regions as well as to boatmen in general.

FIG. 3.—ELECTRIC BOAT DRIVEN BY DETACHABLE MOTOR AND PROPELLER.

NEW TROLLEY FREIGHT AND CROSS COUNTRY ROADS.

A stock company has been formed composed of Chicago, Valparaiso, Ind. and Hobart capitalists to build an electric road from Valparaiso to Chicago. The cars will be constructed so that light freight can be shipped. The principal backers interested are milk shippers, whose daily business through these two counties amounts to hundreds of dollars. By this scheme they claim they will be able to save thousands of dollars annually.

The supervisors of Lee County, Ill., have granted the right of way through Lee County to the Rockford and Dixon Electric Railroad. Similar action has been taken by the supervisors of Ogle County some time ago. The road is to run from Rockford to Dixon, Ill. Jason C. Ayres, a member of the company, states that work will be commenced as soon as frost is out of the ground.

Work has been begun at Somerville, N. J., on what will be a complete trolley road between New York and Philadelphia. The contractors now at work are under bonds to complete by April 10 the first five miles of the New York and Philadelphia Traction Company's proposed electric railway between the two great cities.

The first rails will be laid at Raritan, after which the construction of the road is to proceed at the rate of one mile a week until it connects Somerville and Bound Brook with New Brunswick. Between Somerville and Bound Brook the rails will be laid along one side of the public highway. This plan is to be generally enforced by the county and township officials as a means of lessening the dangers of the trolley and the obstruction of travel on the highway.

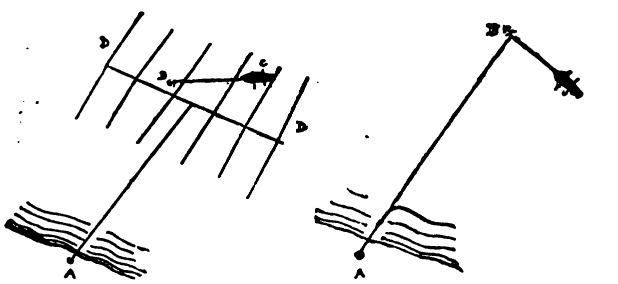
Between Raritan and New Brunswick is an agricultural district. The Traction Company intend to cater to the needs of the farmers, and is having built a number of combination cars that will enable the farmers to carry with them small quantities of produce to market.

TELEPHONE.

TELEPHONIC COMMUNICATION WITH LIGHTSHIPS.

Prof. Lucien I. Blake, in a report recently submitted to the Government describes the method employed by him to telephonically connect the Scotland Lightship with the shore at Sandy Hook. Before the experiments at the Hook took place Prof. Blake succeeded in establishing communication between a lightship and the shore at Wood's Holl, Mass., by the method shown in Fig. 2, in which the telephone cable is fastened to the anchor chain. This worked well until the lightship dragged her anchor during a gale and snapped the cable.

In the experiments at Sandy Hook, however, new conditions presented themselves and the Wood's Holl system would not answer, so the arrangement shown in Fig. 1 was adopted and found satisfactory. Instead of the telephone cable passing through the fluke of the lightship anchor, and communicating as in the other case, through the anchor chain with the vessel, the cable is run to a spot near the lightship's anchor, within the field of the ship's circular swinging with the wind and tide and this field itself is electrified. Another and smaller cable is attached



FIGS. 1 AND 2.—TELEPHONIC COMMUNICATION WITH LIGHTSHIPS.

to the end of the first cable and runs at right angles to it in both directions. From this new cable again other still smaller cables run parallel to the first. In this way the field through which the lightship moves in her movements around her anchor is thoroughly and equally electrified.

The Lighthouse Board has proposed to connect two such stations much further apart, where the conditions of the bottom, currents, and approaches are different. The places mentioned for these experiments were the Assateague Lighthouse, Virginia, to the Winter Quarter Shoal Lightship, distant eleven miles, and from the Cape Fear Lighthouse, North Carolina, to the Frying-Pan Shoals Lightship, distant eighteen miles. The most important recommendation in this respect, however, is to lay a cable from Sankaty Head Lighthouse, on the island of Nantucket, Massachusetts, to the Nantucket New South Shoal Lightship, thirty miles south. This lightship is the most distant from the coast of any in the service and is in the track of all coasting vessels going outside of Nantucket from north to south, and of vessels going to and from Europe.

TELEPHONE NOTES.

CARTERSVILLE, GA., is to have a telephone exchange.

BOWLING GREEN, KY.—The Bowling Green Telephone Company has reduced its rates $6 per year.

MARLBOROUGH, N. Y.—The West Shore Telephone Company will extend its line to Newburgh early in the spring.

TROY, GA.—Troy has succeeded in securing enough subscribers to justify the telephone company in putting in a local exchange.

WARREN, O.—Business men of Warren and Niles, O., have effected an organization and propose to establish telephone exchanges in the two places.

CHARLESTON, S. C.—The long distance telephone now in construction between Augusta and Charleston has been opened as far as Aiken and works perfectly.

HARTFORD, CONN.—The Southern New England Telephone Company is now operating in this State 10,545 miles of wires, of which there are 1,265 miles under ground now in continuous operation, and considerably more which will not be put to work until spring. The company has a total of 5,493 subscribers and of these 4,796 are on the metallic circuit wires.

SAGINAW, MICH.—The indications are that a company of valley capitalists will be formed to adopt the American 'phone and that they will get the valley franchise.

BOSTON, MASS.—Articles of incorporation have been filed in Illinois for the Cushman United Telephone Company, with a capitalization of $20,000,000, to build telephone and telegraph lines.

ROCKLAND, MASS.—Officials of the Southwestern Massachusetts Telephone Company are now completing plans for the extension of the telephone service through to Scituate and from there to Brant Rock.

NEW ORLEANS, LA.—An ordinance has been introduced authorizing the construction, maintenance and operation of a telephone and telegraph exchange in the city of New Orleans, and in connection therewith a system of telephone and telegraph lines in and through the streets of said city.

FORT SCOTT, KAS.—The Mutual Telephone Company, lately organized in this city to compete with the Bell Company has gone into actual operation. The new company is using the Reynolds transmitter and subscribers are only charged $1 a month, while the Bell Company collected $4 a month.

PENSACOLA, FLA.—The organization of the new telephone company has waked up the Bell Telephone Company. The rates heretofore have been $40 a year for residences and $60 a year for business offices. The company has just given notice that from March 1 they will reduce the rate to $30 a year for residences and $40 a year for business offices where the whole amount is paid in advance.

OYSTER BAY, L. I.—The Queens County Telephone and Telegraph and Supply Co. have been organized to connect the village of Oyster Bay, Queens County, with the village of Huntington, Suffolk County, by way of Cold Spring Harbor from Oyster Bay to Hicksville by way of Syosset and intermediate points; from Oyster Bay to Flushing by way of Glen Cove, Roslyn and intermediate points. Capital, $20,000; Directors: W. L. Swan, G. W. Foller, Samuel Y. Bayles, of Oyster Bay; U. S. Croft, of Brooklyn; R. Downing, W. F. Johnson and E. Morgan Griffin, of East Norwich.

LITERATURE.

Electric Motive Power. By Albion T. Snell. London, 1894. The Electrician Printing & Publishing Co. 408 pp. 5 x 8. Price, $4.20.

THE most serious difficulty with which electrical engineers have had to contend is the fact that actual progress has been so far ahead of the literature on any given branch of the art. This requires each engineer or group of engineers to arrive at results by almost independent invention and experiment,—a very difficult and inefficient process. No branch of electrical engineering is advancing more rapidly than electric power and the demand for correct and up-to-date information in regard to it is intense. The present volume is therefore a welcome contribution, since in many respects it fulfills its purpose. The book opens with a brief but clear explanation of the principal points in the design of dynamos and motors. This is followed by a less satisfactory treatment of the line, including overhead and underground conductors. The three systems—direct current, single phase, and polyphase—are then taken up and discussed separately in a reasonably thorough manner. The last 84 pages are devoted to the applications of electricity to mining, the treatment being quite complete considering the novelty of this important subject. The chief criticism to be made concerning this book is that while each machine or other element is described in considerable detail, the systems as a whole are not adequately treated. The practical management of the machinery while actually at work, is also neglected, as usual, in electrical books. Questions of cost, finance, general efficiency, and *uses* of electric power (with the exception of mining) are hardly considered. Steam and gas engines as well as water wheels are also ignored. In short, electrical engineering in its broadest sense is not covered.

Nevertheless, the book is recommended to those who desire to find an intelligent and fairly complete description of the principles and construction of each of the various forms of electrical apparatus employed in power transmission.

TWO YEARS' LIGHTING BILLS UNPAID.

The city of Ashland, Wis., not having paid for its street arc lights for two years, the Lighting and Street Railway Co. has decided that it is best to cut off the service. The streets are dark and the citizens are nervous, but what is to be done about it?

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CONTENTS.

THE FENDER CRAZE.

THE mayors and inhabitants of some of our cities are going daft about fenders for street cars. It is in a way a repetition of the early craze for guard wires. In some places fenders have been made compulsory, in others they soon will be. Now we have nothing to say against the proposition that a fender may save life and limb. Probably the best fenders now on the market may be useful once in a while. But we know that some of the fenders are dangerous delusions and that it is a better principle to avoid knocking a foot passenger down than to chance picking him up alive but in a more or less bruised and mutilated condition. Several cases have been recorded of late in which people struck by fenders have not only been injured but killed.

To us it seems to be altogether the better way to give the cars improved braking facilities. Then the fender can be added, if desirable, but as a general thing these fenders have many elements of undesirability. They obstruct the street more or less. They add to the driver's cares and demand special attention, instead of relieving him of strain and worry. They act after the event instead of before it and instead of preventing it. Cable or electric street cars often make locomotive speed. They are permitted and adopted because they can give the public such speed. If they did not, it would be better to go back to horses. But on a locomotive, the cowcatcher does not replace the air-brake. How can it?

The main, vital, essential thing to-day with all fast-running cars is to give the drivers swift, direct, easy control of the speed of their vehicles, and this is to be done only with brakes that act instantaneously. If there is to be any legislation, let it be of a kind looking to the adoption of good brakes. A car with its running gear all housed around with a light valence close to the ground and furnished with an efficient brake can maintain high speed and will take no life that is not sacrificed to it. Accidents there will always be so long as humanity is weak, careless and erring; but cars equipped as we suggest will be juggernauts only to willful suicides.

THE EXTREME COSTLINESS OF MUNICIPAL LIGHTING PLANTS.

Our readers will bear witness to the alacrity with which we have placed on record in our columns all the instances and facts that bear favorably upon the subject of municipal lighting plants. We hope and expect to record other data bearing testimony to the efficiency and economy of municipal management, and we shall be the more ready for it because there is so much in the opposite direction. No one can deny, for example, the force of the trenchant article in our issue this week by Mr. I. C. Wood, in which he meets the advocates of municipal plants boldly and downs them by sheer force of statistics. Mr. Wood takes up the classical Foster inquiry made by THE ELECTRICAL ENGINEER and brings in other figures, such as those of Mr. Buckley, with the result that public lighting by the public appears to be pretty expensive work.

In this connection it is proper to note the striking article by Prof. W. J. Meyers in the March *Political Science Quarterly* on the much vaunted municipal lighting of

Chicago. Without in any wise attempting to throw doubt on the ability or the integrity of the personnel of the Chicago municipal force, the author of the article has no trouble in showing that each arc lamp supplied by the city to itself costs no less than nearly $168—to be exact, $\$167.78\frac{044}{1110}$. We do not believe there is a city in the country that pays a private plant any such sum; if there be we hasten to congratulate the company holding the contract. An average price to-day for an all-night 2000 C. P. arc is 35 or 40 cents, which falls far short of the Chicago figure. Prof. Meyers does not hesitate to say: "It is extremely doubtful that the city has saved any money by operating a plant of its own prior to 1893, and it seems very probable that the expense of operation in 1893 *considerably exceeded the amount paid for hired lamps.*" If this be true, and there is no evident flaw in the statistics or the deductions therefrom, Chicago is not a case to be cited any longer by the advocates of municipal lighting plants, but to be sedulously avoided by them. Even if a for bigger plant were to be run at full blast, Prof. Meyers cannot get his cost price below $128.86 per lamp per year; and there are few local companies that would not discount that.

PSEUDO-SANCTITY IN SCIENCE.

Justice compels us to take note of an occurrence connected with the annual exhibition of the New York Academy of Sciences, of which an extended account will be found in our pages this week. Among those who were *specially invited* to take part in this exhibition, which the official catalogue carefully designated as one of "recent progress in science," was Mr. A. E. Woolf, the remarkable properties of whose "electrozone" have been described in our and other columns. During the press exhibition in the afternoon, prior to the public view in the evening, Mr. Woolf exhibited quietly a simple electrolytic cell, in which the hypochlorites were generated; and the action on living organisms was demonstrated under the miscroscope. We may say, without reflecting on the value of other exhibits in this generally admirable collection, that Mr. Woolf's display struck us as one of the few there of novelty and of pre-eminent importance. Yet, strange as it may seem, Mr. Woolf was requested to remove his exhibit after the press exhibition, without being vouchsafed so much as an intelligible explanation.

We consider those responsible for this proceeding as guilty not only of gross discourtesy but of flagrant injustice. Viewed from the standpoint of science, and its progress, it seems to us that a process which has undeniably effected most remarkable results in the disinfection of sewage, in the purification of water, and in medicine and surgery, as attested by leading medical authorities, is certainly worthy a place alongside a job-lot of kinematic models that have been the stock apparatus of mechanical laboratories these thirty years. There was nothing about Mr. Woolf's exhibit to which the most squeamish could take exception on the score of "advertizing" except possibly his own enthusiastic way of talking about his work. He had no "circulars," no "literature." If his exhibit indirectly advertized "electrozone," what were Messrs. Willson and Dickerson doing with their admirable display of acetylene gas? If President Rees and his coadjutors desired to stop "advertizing," why did Messrs. Foote, Ives, Hopkins and others exhibit and hand out cards or circulars of their excellent minerals, lanterns, photographic inventions, etc.? Why did a photogravure company have a large corner in which each picture bore its trade label? Why——, but enough. We could mention a dozen cases where the advertizing was rank, open and unchecked, and we advise the Society, which has no warmer friend and admirer than ourselves, to rid itself of the pseudo-sanctity and apparent wreaking of personal spite shown last Wednesday.

POINTS ABOUT LOCOMOTIVES.

Mr. William Baxter Jr., who, as is well known, has long given his attention to motor problems, furnishes a pithy article to our columns this week on the differences between electric and steam locomotives, making not a few points that appear to favor the former. As Mr. Baxter remarks, it has ceased to be a mere computation on the relative rates of burning up coal in a big power house and in a number of small units. Other items and factors have come into the account, and we must look also at questions of repair, ability to make large, continuous mileages; the reduction of train and car weights; the consequent lessening of labor and wear and tear. Mr. Baxter's brief outline of some of these conditions suggests a number of interesting lines of thought, which he will himself, we hope, follow up. It is encouraging to see men of his stamp so prompt and ready for the new work now pressing in upon the electrical engineer from the domain of traction.

Rail Bonds.

THE necessity for a good return circuit for electric railway currents as a saver of power not less than as a conserver of gas and water pipes has given special prominence to the best means of securing the full and constant conductivity of the rail. Railbonds are getting to be almost as numerous as car fenders and as the proverbial car coupler. Experience and time alone can demonstrate the ultimate virtue of any such device placed as it must be under the most disadvantageous conditions and surroundings. The problem is by no means easy of solution and we are glad to know that it has attracted the attention of Mr. Edison, who with his characteristic energy and genius attacked it several years ago, and has awaited the test of time to demonstrate the efficacy of the various methods tried by him. The Edison "plastic" rail bond described on another page is based on sound scientific principles and seems destined to afford relief from a serious evil. The tests, both electrical and time, certainly show it to possess remarkable qualities approaching very closely the welded joint.

THE destruction of Mr. Tesla's laboratory by a fire due to the carelessness of a lazy or stupid watchman is a very serious loss to the inventor and to the world; but it takes more than a fire to set back an inventor of such dauntless courage and such indefatigable originality.

THE "consolidation" rumor of which we made mention last week has since then been steadily working through the rounds of the press. The only material change now is that the name of the Electric Storage Battery Co. of America has been added to those of the General Electric and Westinghouse Companies; and perhaps we shall presently see the American Bell and Western Union thrown in also.

MISCELLANEOUS.

THE MONOCYCLIC SYSTEM DISCUSSION.—II.

MR. C. F. SCOTT:—Another point in connection with the lines is the unbalancing of circuits. It was stated that the two-phase three-wire circuit is one which is liable to unbalancing because of the reaction of one circuit upon another. While this is true in certain cases, in ordinary working these would be met with but seldom. The next point in the system, after going through our transmission circuits, is the transformer. The transformers for transforming a given amount of energy for lighting or for power, by the two-phase system, in which one transformer is placed on each of the two phases, is the same as that for the single-phase system. For the three-phase system, in which transformers are connected across each pair of mains, the converter capacity is the same; that is to say, if we have six transformers, we may connect them in parallel across the single-phase circuit, or we may connect them in two sets of three each on a two-phase system, or we may divide them into three groups of two each on the three-phase circuits, and each transformer will have the same individual capacity in each position. When, however, these transformers are connected as in the diagram illustrating the monocyclic two-wire system, then, as has already been pointed out, they do not operate in their ordinary way. Although the E. M. F. upon them may be normal, the currents flowing through the transformers differ from those in ordinary cases. They are not in phase with the E. M. F. upon the transformers, and the output of the transformers is reduced by a very appreciable amount—if I am correct in my present recollections, some 16 per cent. Thus, transformers of about one-sixth greater capacity would be required for operating a motor under this system above that which would be required if the same motor were operated by two-phase or three-phase systems.

The transformers in the monocyclic three-wire system also seem to require an excess capacity. If the large transformer in that diagram is the one which supplies the lights and operates the motor when the motor is doing something, then the little auxiliary or teaser transformer is one which is useful only at the start, and contributes nothing to the regular working of the motor, according to the assumptions which have been made. This transformer, therefore, is an additional piece of apparatus which must be provided in the system.

With regard to the motor itself, I observe that the motor in the monocyclic two-wire system is a three-phase motor and nothing else. I understand that the motors used are the standard three-wire motors, and the motor itself does not know the difference, where it is getting its supply, whether from a regular three-phase system or a two-wire monocyclic system. The transformers for this motor on the three-wire three-phase system would naturally be the three. We seem here to have cut off a part of this system by cutting out one of the transformers. We are not keeping the symmetrical arrangement now, but are supplying the motor by but two transformers, leading to the result to which I have just called attention, that is, a larger transformer capacity. The reversing of the secondary coil of one of the transformers, if I understand the connections and arrangement, would be obviated, and the transformer would be connected directly without this crossing if the primaries of these transformers were directly connected to three-phase mains. Suppose we have a system, then, with three-phase mains with three transformers connected, feeding respectively the three circuits of the motor. Now we cut out one of these transformers, but our motor will still run, but without the same efficient performance of the transformers. If we change the relation of the middle wire at the dynamo, or change the voltage of this wire, we can do so in such a proportion that the phases of the two primary circuits will not have their former relation—will not be 120 degrees apart, but 90 degrees apart. In this case, it becomes necessary to reverse one of the secondaries in order to obtain two currents 120 degrees apart for operating the motor. If, therefore, the teaser coil were wound with a different number of turns to give a higher E. M. F. we might have a three-phase generator supplying directly three-phase mains. What this seems to be, then, is really the elements of the three-phase system distorted somewhat by changing the E. M. F. on the middle or teaser wire and reversing the secondary of one of the transformers and leaving out the third transformer. So much for the motor which operates from the two-wire monocyclic system.

The motor on the three wire system seems to have somewhat different relations. This is not a three-phase motor, but, I take it, is a two-phase motor, and it is rather interesting.

DR. BELL: It is a three phase—the same motor as the other.

MR. SCOTT: Very good, but on the diagrams I have seen of this monocyclic motor, I have taken it as a two-phase motor, the two windings being given in the diagram as two coils placed at right angles to one another. The very reason for bringing up this discussion and making it so full at this time, is to get a correct understanding of these motors. The understanding which I got from the diagrams and explanations which I have seen of the system, seem to me to represent a two-phase motor, one of the circuits being wound through, directly similar to the monocyclic generator. This motor has been pointed out—I do not remember whether in the paper Dr. Bell has just read, or not—as similar to the monocyclic generator, which is stated to be a single-phase machine, wound with one winding straight through from one end to the other, with this little auxiliary or teaser coil connected between the middle of that coil and a third terminal. If this be the case, then it seems to me that this motor is either a single-phase motor or a two-phase motor. The explanation given of the operation of this motor has not been very complete to-day. If I make a mistake in drawing on other sources of information in regard to it, I hope I will be corrected.

This motor I have taken to be a single-phase motor when running at speed, but essentially a two-phase motor, which is supplied by the three wires which are operated by two transformers which have E. M. F's. at right angles, or the 90-degree relation of the two-phase motor. We are supplying, then, to this motor the output of two converters which are operated at a difference of 90 degrees. All the circuits of the motor are active while the motor is coming up to speed. One of the windings on the motor is somewhat different from that of the windings on the transformer; it is not exactly proportioned in both of its circuits to the E. M. F. supplied, so that when run at speed one of the circuits does all the work. It is very much as if two transformers are connected in parallel, one giving 100 volts and the other 99 volts. If we put a load on the transformers connected in multiple until the E. M. F. drops to 99 volts, then one of the transformers would be carrying all the load and the other nothing. The motor described here is the same motor, if I understand it correctly, as is described in the patents granted to Mr. Steinmetz. Then it seems to me that this motor is very similar to a sort of lop-sided two phase motor, stronger on one side than the other. The two circuits operate with fair effect to bring the machine up to speed and then one of the circuits takes all the load and the other has but little to do. The motor in running at full speed and doing its regular work operates as a single-phase motor. A single-phase induction motor will not carry the same load that the two-phase induction motor will. Any one who has operated two-phase induction motors knows that one circuit may be cut out and the machine will continue to run, but it will not carry the same load as before. If that be true and the information upon which I understand the connection of this motor be true, then this monocyclic motor seems to be a rather decrepit two-phase motor.

THE PROPAGATION OF MAGNETISM IN IRON.

On Feb. 21 Dr. John Hopkinson and Mr. E. Wilson read a paper entitled as above before the London Institution of Electrical Engineers. The paper, of which we can give only a very condensed abstract, is of a most valuable nature and was accompanied by numerous diagrams and curves.

It has, of course, been long known that in electro-magnets with solid iron cores currents are induced in the solid iron when the magnetizing current is reversed, and that these currents for a certain time retard the development of changes in induction. The existence of these currents was shown to the audience by aid of reflecting galvanometers inserted in the circuits of exploring coils inserted at different depths within the core, and the astonishing fact was revealed that the propagation of the magnetism takes place progressively, the outer zones of the core attaining their full magnetization before the inner zones become affected to any sensible degree. Further, it was shown that the time required for the action to become complete may be very long when only a small magnetizing force is employed, and even with a large force it may occupy the best part of a minute with apparatus of the size employed by Messrs. Hopkinson and Wilson. When the current in the magnetizing coil is reversed, the magnetic flux in the core is also reversed, of course, and this gives rise to electric currents in the iron. These currents circulate round and round the core, and in so doing they oppose the propagation of the magnetism towards the centre. Until the currents die out, expending themselves in heat, the magnetism cannot get deeper into the iron, and in each layer or zone into which it penetrates it induces a fresh set of currents, so that its propagation is continually delayed, and each advance is met by a fresh resistance.

The magnet employed was 12 in. in diameter, and was surrounded by coils. To complete the magnetic circuit the core and the coils were entirely surrounded by iron, by means of two discs and a hollow cylinder.

In one experiment it was shown that it required no less than four minutes for the magnetism to penetrate to the centre of the bar and become constant there. This experiment was made with a magnetizing force of 2.4 C. G. S. units per centimetre length of the magnetic circuit. It was followed by three others with magnetizing forces, respectively, of 4.95, 15, and 24, but the period was gradually reduced until in the last case 50 seconds elapsed.

A last experiment was made with alternating currents of gradually diminishing periods, beginning with one of eight

minutes' pediodic time, but proceeded so slowly that it was not persevered with to the end. The purpose was to show that when the periodic time of the current fell below a certain amount, the central portion of the magnet did not respond to the reversals of current. For instance, working with a magnetizing current that required four minutes to propagate its action to the centre of the core, it is evident that if it were reversed every four minutes, that is, if it had a period of eight minutes, the centre coil would cause its spot of light to make its excursion and back again in due course after each reversal. But if the reversals were gradually made at shorter and shorter periods than four minutes, No. 1 spot would make a shorter and shorter excursion, until at length it ceased to move at all, and the central part of the magnet would become inoperative and useless.

From the readings of the galvanometers there can be deduced the electromotive forces at different depths in the iron, and from these results there can be obtained the magnetic induction at the same depths, and the relation of the induction to the magnetizing force.

It is possible to pass from the results obtained with this apparatus to those which should occur with apparatus of different size, since the time required for the propagation of the magnetism is proportional to the square of the linear dimensions. Thus a core 1 in. in diameter would be fully magnetized, under similar conditions, in $\frac{1}{144}$th of the time required for a 12 in. core. A transformer core made of wires of 1 millimeter in diameter, would be magnetized in about $\frac{1}{90,000}$th part of the same time. Plates require about twice as much time to go through their changes as wires of the same thickness; that is, a plate ½ mm. thick requires the same time as a wire 1 mm. thick. An examination of the thickness of the laminæ used in transformer cores ½ mm. thick and armature discs 1 mm., shows that practice has settled them at the dimensions theory would indicate, and that they could not be made much thicker without loss, while to make them thinner would be of no advantage.

STUDENTS' SIMPLE APPARATUS FOR DETERMINING THE MECHANICAL EQUIVALENT OF HEAT.[1]

BY W. E. AYRTON AND H. C. HAYCROFT.

THE authors set themselves to design an apparatus which, when used with a good commercial ammeter, voltmeter, thermometer, and watch, would give the value of the mechanical equivalent of heat correct to one per cent., without any corrections having to be made even for the heat lost by radiation, convection, and conduction, and without any special manipulative skill being required on the part of the observer.

Broadly, the experiment consists in passing a known current through a resistance immersed in a known mass of water, and measuring the rise of temperature in a given time, and the average value of the P.D. between the terminals of the resistance.

The measurements to be made are as follows :—

(*a*) The value of the constant current passed through the resistance. (*b*) The average value of the P.D. between its terminals. (*c*) The mass of water heated, to which must be added the water-equivalent of the containing vessel, resistance-coil, and stirrer. (*d*) The rise of temperature of the water. (*e*) The time during which the current is passed.

In the particular case for which the apparatus was designed the number of watts available was about 300, the maximum current being 30 amperes. This determined the resistance of the coil or strip as ⅓ of an ohm.

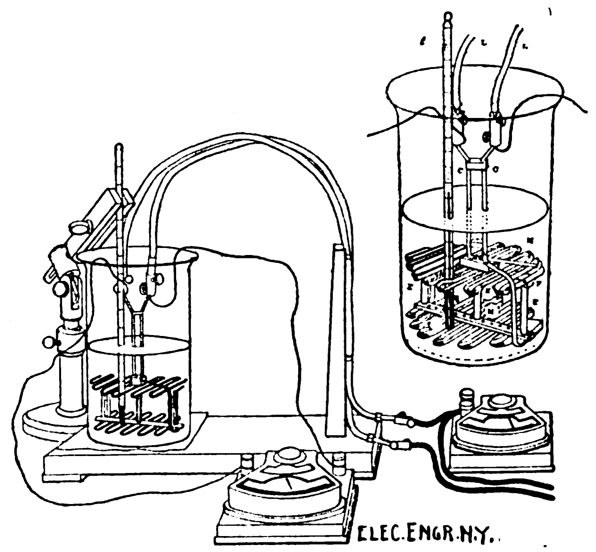
The average emissivity for small excess temperatures of a glass vessel standing on a felt base and containing water was obtained by taking cooling curves, the mean value being 0.000232 calorie per square centimeter of area per 1° C. excess temperature. The water was kept at a uniform temperature by means of a light wooden stirrer during these experiments.

It can be shown that under the conditions of the apparatus employed, the rise of temperature adopted should be 3.87 degrees, the time being 2 minutes 20 seconds. The numbers actually adopted in the experiments were 2000 cubic centim. of water and a time of 2 minutes; the smaller quantity of water being adopted because the resistance of the immersed strip when made proved to be rather less than ⅓ ohm, the watts taken at 30 amperes being 260 instead of 300.

A strip of manganin (chosen on account of its low temperature-coefficient), about ¼ inch wide, 0.03 inch thick, and about 5 feet long, was bent into a series of zigzags (Fig. 2) so as to form a kind of circular gridiron, M M, in which the successive portions of strip lie all in one plane, the whole being held rigid by a strip of vulcanized fibre F crossing the gridiron and to which each portion of strip was screwed. Another precisely similar gridiron was placed 3 inches below the first, and they were held together by three thin ebonite pillars E screwed to the strips of vulcanized fibre, the whole forming the top and bottom of a sort of cylindrical box, 5 inches diameter and 3 inches high. The two grids were joined in series, and the ends of the strip of manganin were soldered to two copper wires C C, about 0.128 inch thick and 6 inches long, which were insulated from one another by vulcanized fibre separators, and constituted a kind of handle by means of which the open box could be moved up and down in the containing vessel.

The whole surface exposed to the water received a thin coat of varnish to prevent any electrolysis due to the difference of potential between the different parts of the strip. At two points in the same vertical line the zigzags forming the two grids are bent so as to leave a space for the passage of a thermometer *t*, the bulb of which is midway between the grids when the lower one is resting on the bottom of the vessel. The whole heating surface exposed to the water is about 60 square inches, or 400 square centimeters. The vessel used to hold the liquid is a thin glass beaker of just sufficient diameter to take the framework of manganin strip.

Two thousand cub. centim. of water were used in all the experiments, and were measured with a graduated glass jar, fresh



APPARATUS FOR DETERMINING THE MECHANICAL EQUIVALENT OF HEAT.

water being used in each experiment. The weight of the glass vessel up to the water level was determined as 184 grammes, and the specific heat being about 0.2, the water-equivalent is 37 grammes. The weight of the manganin strip is 114 grammes, and the specific heat being about 0.09, the water-equivalent is 10; the equivalent mass of water used being therefore 2047 grammes.

The mean temperature of the water in the experiments was 15 degrees Centigrade; and the final result was that at that temperature 0.2375 gramme of water are raised 1° C. in temperature by the energy of one watt-second.

Since we find the equivalent of the watt-second in gramme-degrees at 15° C. to be 0.2375, we have at once, taking 10^7 ergs equal to one watt-second, the mechanical equivalent of heat in ergs per gramme-degree at 15° C. equals 4.211×10^7. Reducing this to foot-lbs. at Greenwich per lb.-degree C. at 15° C., it becomes 1408, or in foot-lbs., per lb.-degree F. at 59° F. it is 782.

A later series of four experiments gave 779 foot-pounds.

ANNUAL EXHIBITION OF NEW YORK ACADEMY OF SCIENCES.

THE second annual reception and exhibit of recent progress in science of the New York Academy of Sciences was held in the galleries of the American Fine Arts Society on the evening of March 18 and attracted a large and enthusiastic throng of visitors. The department of electricity was in charge of Prof. F. B. Crocker, who himself exhibited various interesting devices. Among them was the armature of a unipolar dynamo consisting of a cast iron wheel, having a face 11 inches wide and 14 inches in diameter, the brushes being applied at the extreme ends of the face. This armature is capable of being subjected to a magnetic induction of 6,000,000 lines of force, and of developing an E. M. F. of six volts. It was a centre of great interest all the time.

In order to illustrate the peculiar effect of wear on commutators there were exhibited a number of these, one in particular showing a most remarkable cutting away in the shape of a semicircular bead done as smoothly as if cut in a lathe. Prof. Crocker also exhibited a standard international ohm, a wattmeter, an electric dynamometer, by Nalder Bros., and a model showing the construction of the latest type of armatures for dynamos and motors, in which the conductors in the shape of bars are embedded in slots, and cross connected by spiral connectors.

Prof. M. I. Pupin exhibited several interesting novelties,

1. Abstract of a paper read before the Physical Society on November 23, 1894.

Among these was a polyperiodic alternator, employed by Prof. Pupin in his resonance multiplex telegraph system. The machine is designed to impress upon the circuit simultaneously four fundamental frequencies, each individual frequency being picked out by selective apparatus at the other end of the line. Upon the shaft of the machine are located, side by side, four rotating fields, of the Oerlikon type, which are surrounded by four stationary armatures, which in this case consist of coils similar to the ordinary radial field coils of alternating machines. The number of poles in these armatures are respectively 18, 22, 26 and 30, so that the number of periods varied from 320 to 600 per minute. By the winding adopted the E. M. F. developed in the coils is respectively 900, 1100, 1200 and 1800 volts, the 18 pole field having the greatest E. M. F.

Beside this machine was shown a transformer designed especially to weed out the upper harmonics in complex alternating current impulses. This transformer consists of a closed iron ring core, two-thirds of which is covered with the primary coil and the remaining third with the secondary. The suppression of the upper harmonics is due to their inability to penetrate the iron and produce magnetization, and this object is attained in the coil by securing a construction such that there is magnetic leakage with a perfectly closed magnetic circuit, together with a proper thickness of iron. Prof. Pupin also exhibited an electrostatic voltmeter for very low voltages, by Elliott Bro's.; the needle consists of two narrow vertical strips of aluminum swinging between two vertical "quadrants" of like shape. An air condenser, by Elliott Bro's., was also shown, consisting of brass discs eight inches in diameter and eighteen inches high, having a capacity of 1/10 microfarad. Prof. Pupin also showed a Kelvin multicellular electrostatic voltmeter and several coils, one having a selfinduction of one Henry divided into fifteen sections, and another divided up into sections so that the self induction and mutual induction could be varied by varying the position of the contact lever. In the department of mechanics Prof. Pupin showed an automatic Sprengel vacuum pump, in which mercury is by suction raised in successive stages to the height of six feet six inches.

A number of applications of electricity were also shown in the other departments. Among them we noticed specimens of carbide of calcium, produced in the electrical furnace, and employed in Mr. T. L. Willson's process for obtaining acetylene gas for illuminating purposes. The gas was made on the spot in a small generator. The apparatus was exhibited by Mr. E. N. Dickerson.

Mr. A. E. Woolf had in operation an electrolytic cell generating hypochlorites and exhibited a number of specimens, illustrating the respective action on albumen of carbolic acid, sulphuric acid, bichloride of mercury and hypochlorites, the latter alone causing a complete disintegration of the albumen. Mr. Woolf also showed bacteriological specimens under the microscope, and demonstrated the immediate cessation of all life in them upon spraying them with hypochlorite.

Among the photographs in the department of astronomy we noticed one of a lightning flash and exhibiting the most remarkable characteristics in sub-division and reversing of direction of the discharge. This was exhibited by Mr. S. W. Bridgham, M. E., president of the New York Camera Club.

In the department of Physics, in charge of Prof. Alfred M. Mayer, Prof. H. Cushman exhibited a five-arc potentiometer for accurate measurement of E. M. F's. and an improved discharge key. Mr. H. C. Parker showed bridges for measuring very high and very low resistances respectively.

In the department of Physiology much interest was shown in the apparatus for the study of the contraction of muscle. A chronograph indicated the time in 100th of a second and the electric impulse given to a frog's leg from a DuBois-Reymond coil caused a movement which was traced on the chronograph cylinder.

We also noticed specimens of carborundum and the materials employed in its manufacture, as well as an electric plate heater.

EDUCATIONAL.

A COURSE OF LECTURES ON ELECTRO-CHEMISTRY, AT JOHNS HOPKINS UNIVERSITY.

There has been started at the Johns Hopkins University, Baltimore, an addition to the present electrical course, consisting of lectures on laboratory work on Electro-Chemistry. The work is being done by Mr. H. C. Jones, Ph. D., who has had a thorough training in this country and abroad under Ostwald. The course consists briefly of:

1st. A historical sketch of Electro Chemistry, including theories on electrolysis. 2nd. Electrical Energy. 3rd. Discussion of the laws of Faraday. 4th. The Wandering of ions. 5th. Conductivity methods and results. 6th. Properties of ions. 7th. Electro-motive force. 8th. Polarization. 9th. Electrolysis. 10th. Electro-chemical analysis. 11th. Electro-Metallurgy. There will be laboratory work in Electrolysis and Electro-Metallurgy, and in such experiments as conductivity methods, etc. This course will be elective this year. It is attended by fifty students, of whom twenty-seven are Electrical Engineers, nine Physicists, and fourteen Chemists.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 12, 1895.

Accumulators:—

Method of Constructing Secondary Batteries, A. Hough, San Francisco, Cal., 535,541. Filed Sept. 14, 1893.
Mixes dry mon-oxide of lead and sulphate of magnesia with water and sulphate of ammonia; after spreading on the plate and allowing it to set the sulphate of magnesia is dissolved out.

Alarms and Signals:—

Electric Burglar Alarm and House Call, H. L. Carpenter, Minneapolis, Minn., 535,484. Filed April 16, 1894.
A system which admits of a great variety of uses; embodies a strip or time sheet which is punched in conformity with the operating of the door or other device to be controlled, together with other combinations.
Railway Signaling Apparatus, W. H. Walsh, Albany, N. Y., 535,565. Filed Jan. 24, 1895.

Conductors, Conduits and Insulators:—

Wire Joint, N. W. Lillie, Somerville, Mass., 535,592. Filed Jan. 31, 1895.
The wires are inserted in the curved portions of an S shaped strip and then twisted.
Insulator, W. J. Belcher, Hartford, Conn., 535,660. Filed Jan. 16, 1895.
Specially designed for electric railway use.

Distribution:—

Electric Lighting System, J. I. Conklin, Brooklyn, N. Y., 535,443. Filed July 30, 1894.
Especially adapted for lighting railway cars; consists of automatic means for connecting and disconnecting the generator with the battery, depending upon the speed of the car.

Dynamos and Motors:—

Starting Alternating Motor, O. Chytraeus, Pittsfield, Mass, 535,530. Filed Dec. 4, 1894.
Changes some of the coils from being closed respectively upon themselves to being opened, the remaining coils being in circuit with one another.
Armature Conductor for Dynamo Electric Machines, H. Geisenhoner, Schenectady, N. Y. & C. Sandman, Niskayuna, N. Y., 535,579. Filed Jan. 15, 1895.
The conductors are wound with spaces between the successive convolutions so as to permit circulation of air.
Regulation of Dynamo Electric Machines, C. D. Haskins, Brooklyn, N. Y., 535,797. Filed Aug. 6, 1894.
Claim 1:
The combination with a dynamo electric machine having two sets of field magnet pole pieces and connected with the circuit of the machine, of an automatic switching device adapted to control the amount of wire of the coils of one set that shall be traversed by the current, and to control the direction in which the current shall traverse the wire of said coils, or portion thereof.
Construction and Regulation of Dynamo Electric Machines, C. D. Haskins, Brooklyn, N. Y., 535,796. Filed Aug. 6, 1894.
Similar to the above.

Railways and Appliances:—

Closed Conduit Electric Railway, E. M. Bentley, Boston, Mass., 535,345. Filed Dec. 11, 1885.
Claim 2:
The combination with a flexible conduit cover, of actuating devices for moving the cover so as to clear the slot connected to a vehicle, and movable transversely to said vehicle.
Conduit Electric Railway, D. O'Flaherty, Kansas City, Mo., 535,398. Filed Mch. 31, 1894.
Belongs to the class in which the moving car closes successive contact with the main conductor as it passes along, which are opened again after the car has passed.
Electrical Controller, E. A. Sperry, Cleveland, O., 535,511. Filed Nov. 11, 1893.
Designed to convert the motor into a generator for braking purposes. See THE ELECTRICAL ENGINEER Sept. 12, 1894.
Clamp for Trolley Wires, W. W. Annable, Grand Rapids, Mich., 535,534. Filed Nov. 23, 1894.
System and Apparatus for Applying Brakes to Electric Cars, C. E. Davis, Chicago, Ill., 535,679. Filed Dec. 29, 1893.
A magnetic friction brake combined with a mechanically applied brake.

Galvanic Batteries:—

Battery, H. N. F. Schaeffer, Manchester, N. H., 535,464. Filed Jan. 9, 1893.
Claim 4:
The hereindescribed electrolyte for batteries consisting of a mixture of lactic acid, a mineral acid, an alkali and an antiseptic.
Thermo-Electric Generator, H. B. Cox, Hartford, Conn., 535,488. Filed Mch. 8, 1893.
The connections between the sections are internal and within the metallic wall; the metallic pile is coated with plastic material entirely covering the metallic elements.
Thermo-Electric Generator, H. B. Cox, Hartford, Conn., 535,489. Filed Mch. 8, 1893.
Similar to the above.
Thermo-Electric Generator, H. B Cox, Hartford, Conn., 535,490. Filed Mch. 8, 1893.
Similar to the above.
Indicating System for Thermo-Electric Generators, H. B. Cox, Hartford, Conn., 535,491. Filed Jan. 31, 1894.
Relates to a valve controlling the cooling liquid circulated around the generator.

Lamps and Appurtenances:—

Electric Arc Lamp, J. C. Knight, New York, 535,589. Filed Mch. 2, 1894.
A friction feed mechanism; embodies also a novel method for supporting the shade, to facilitate trimming.

Carbon Holder for Arc Lights, A. W. France, Philadelphia, Pa., 535,699. Filed Nov. 10, 1894.

Electrical Fixture, L. Stieringer, New York. Reissued, 11,478. Filed June 6, 1882.

Relates to an insulating joint by which the fixture is supported.

Miscellaneous :—

Electric Heating Apparatus, M. W. Dewey, Syracuse, N. Y., 535,863. Filed Mch. 12, 1894.

Improvement on the inventor's previous patent; consists of details relating especially to car heaters.

Electric Clock Striking Mechanism, F. L. Gregory, Chicago, Ill., 535,870. Filed Jan. 30, 1894.

Electric Switch, M. W. Dewey, Syracuse, N. Y., 535,533. Filed Jan. 11, 1895.

Details of construction relating to a multiple circuit switch for electric heaters.

Electric Cable Way, R. Lamb, New York. 535,703. Filed July 19, 1894.

Covers the system described in THE ELECTRICAL ENGINEER, March 13, 1895.

Process of Purifying Water, O. Lugo, Jersey City, N. J., 535,802. Filed Oct. 30, 1894.

Subjects the water to electrolysis, employing aluminum anodes.

Telephones :—

Automatic Telephone Switch, N. H. Holland, Montreal, Can., 535,540. Filed Aug. 10, 1894.

The switch is operated by a pair of movable ear pieces.

Telephone, W. W. Dean, St. Louis, Mo, 535,615. Filed Sept. 24, 1894

A head telephone for exchange use with an independently operated signal giving device at the other end of the head support placed near by but free from the other ear of the operator.

Telephone Exchange Apparatus, C. F. G. M. B. de la Touanne, Paris, France, 535,745. Filed Dec. 30, 1893.

The system is designed to reduce the number of contacts at the switchboard and to facilitate making of calls, connections and disconnections.

Automatic Central Telephone Switch Apparatus, F. Nissl, Vienna, Austria-Hungary, 535,806. Filed Feb. 17, 1894.

LETTERS TO THE EDITOR.

STORAGE OF ENERGY—A CORRECTION.

In looking over my paper on the "Storage of Energy," etc., read before the National Association at Cleveland, I find an error that does injustice to Mr. Halpin's method of Steam Storage. The figures were correct in my original manuscript but got changed in the haste in transcribing the printer's copy. In the printed copy the fixed investment charges are made to add up $994.89 whereas they add up only $788.39. This is so palpable an error that probably none but the casual reader would fail to detect it. It, however, places this method in a wrong comparative light, and I will feel obliged if you will kindly call attention to the correction.

Making this change, the total fixed annual cost per electrical H. P. becomes $67.00 instead of $87.60 and the total annual cost $97.24 instead of $117.84 with coal at $1.75, and the total annual cost with coal at $3.50 per ton becomes $114.27 instead of $134.77.

Substituting these figures in the final comparative statement it will read thus :

	Recapitulation.		Savings effected.	
	Coal, $1.75.		Coal, $3.50.	
Present method. Steady load	$48.68	65.62		
" Gas Engine	88.28	103.61	29.50	44.79
Combined Feed and Steam Storage	94.42	111.85	23.36	37.05
Feed Storage	97.58	117.58	20.20	30.82
Without storage. Load factor 25%	117.78	148.40	.....	.....
Steam Storage	97.24	114.27	20.54	34.13
Complete Battery Storage	123.13	145.74	—5.35	+2.66

NELSON W. PERRY.

NEW YORK, Mar. 15, 1895.

DESTRUCTION OF THE TESLA LABORATORY BY FIRE.

By a fire which almost completely gutted the six-story and basement building at 33 and 35 South Fifth avenue, this city, on March 13, Mr. Nikola Tesla, the electrician, lost all of the apparatus with which he has been carrying on his professional experiments. He occupied the entire fourth floor. When the floor gave way his apparatus fell to the second story where it lay in unrecognizable ruin. It was not insured.

Gillis & Geoghegan, manufacturers of steam fitters' supplies, occupied the rest of the building. The fire was discovered at 2:30 a. m. John Mahoney, the watchman employed by Gillis & Geoghegan, had, he says, left the office on the ground floor just before that hour to bank the fires in the subcellar, leaving a single gas jet burning. In about ten minutes he returned and found flames running along the floor and up the sides of the partition of the office. Mahoney yelled for a policeman. Policeman Haggerty ran to the watchman's assistance. Mahoney had closed the office door and was pouring buckets of water on the flames. Seeing that this did no good he told the policeman to turn in an alarm. A moment later he was driven into the street by great tongues of flames which shot up from the floor.

Before Chief Reilly with Engine 33 reached the fire the flames had spread to the first and second floors, and were shooting to the top of the building through the stairways, airshaft and elevator well. From top to bottom the building was saturated with machine oils, used in cutting steam pipe, and this ignited with great rapidity. The firemen fought the flames for fully three hours before they were under control. The Sixth avenue elevated road was blocked in the mean time, the firemen using its structure to work from. It was not until 8 o'clock that the recall for the engines was sounded. The walls and framework of the building were still standing, but the north side of the structure was so badly cracked that the tenants of the nearest houses were ordered out again for fear that it would fall.

Mr. Tesla was at first very much affected by the news of his loss, but sustained the blow stoically, and within 6 hours was busily engaged making and giving out designs for the reconstruction of his latest type of oscillator, which has now been running successfully for some time past, lighting the laboratory and supplying current for a number of new and novel experiments. It is needless to add that Mr. Tesla has received innumerable expressions of sympathy and regret not only from friends and acquaintances but from total strangers.

DIVIDENDS.

The American Bell Telephone Company's directors have declared the regular quarterly dividend of 3 per cent.

The Western Union Telegraph Company's directors have declared the regular 1¼ per cent. dividend, as recommended by the executive committee yesterday. The Western Union quarterly statement was not good, the dividend not being earned this quarter by $285,000. It is true, however, that for the nine months ending with this month, the full dividend for the period has been earned, with a margin of $58,000. It appears also, by the comparison, that the company's revenue is increasing rather decidedly over 1894.

FOURTH EDITION OF NOLL'S BOOK ON WIRING.

A gratifying success has attended Mr. Augustus Noll's excellent book on "How to Wire Buildings," which is considered by many the best manual of its class. It contains much that cannot be found anywhere else. The fourth edition is now going through press and will be out in a few days.

PACKARD LAMPS.

The Electric Appliance Company, of Chicago, are entering upon an active campaign for lamp business with the original Packard lamp with platinum leading-in wires as it was made before the time of the incandescent lamp litigation. They are making some very strong claims regarding a rather remarkable improvement which has recently been achieved in the manufacture of the Packard Lamp, by means of which, it is said, the lamp increases in candle power and efficiency during its life. The importance of such an improvement cannot be overestimated, and, if it is true to any marked extent, it will readily be seen that the comparative first cost of the lamp drops almost out of consideration, as a small increase in candle power and efficiency during its life will result in a saving of several times the original cost of the lamp. The trade will undoubtedly hasten to investigate the claims that are being made.

THE USES OF MICANITE INSULATION.

The rapidity with which "Micanite" has taken its place among the standard specialties of the electrical field is both interesting and encouraging. The material has at once found a market and an appreciative public, and is now being made in the greatest variety of shapes, forms and peculiar appliances where the fundamental requirement is perfect insulation. The Mica Insulator Company, of No. 218 Water street, New York, are sending around to their customers,—who without doubt include everyone in the electrical business,—samples of their Micanite Insulation. They draw special attention to the Micanite plate, cloth and paper. The plate, from which commutator segments, rings, etc., are made, is of lighter color, almost transparent, showing a smaller proportion of cement than heretofore. This improvement has been attained by special machinery and greatly improved methods. The Company have grown steadily since their commencement, before and through the general depression, and now that business is looking up, find that they have to double their capacity. Their product cannot but increase in demand as the electrical field grows.

CAPT. SAMUEL TROTT of the cable laying and repairing steamer "Minia" was a visitor to New York last week. His ship lies in Boston harbor getting in trim for work to repair the havoc of the winter on the deep sea cables.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE BRUSH CONSTANT POTENTIAL ARC LAMP.

The growing demand for a reliable constant potential arc lamp for use on incandescent circuits has led the Brush Electric Company, of Cleveland, to design a lamp which will prove satisfactory under the various severe conditions to which such lamps are subject. This lamp, shown in the accompanying illustrations, is claimed to be without any of the objectionable features found in lamps of the clock work type. The absence of springs renders permanent adjustment possible and, as the magnetism acts against the weight of the moving parts, the friction is diminished and the weight greatly reduced.

Among the desirable features of the regular Brush constant current lamp that have been adapted to the new constant potential lamp is the clutch, Figs. 1, 2 and 3, the result of fifteen years of experiment and experience. In this clutch the lever B is supported at H by an armature lever. Fig. 1 shows the clutch gripping the rod, and as the armature moves up and down it will carry the rod also. However, in descending, the clutch will only grip the rod until the trip E touches the plate F, when any further fall of H will release the rod by pulling C back as in Fig. 2. The raising of the armature lever at H immediately closes the clutch and lifts the rod with the lever. This clutch presents such a long gripping surface that a dent or enlargement in the lamp rod will not affect its operation in the least. The opening G, Fig. 3, is of such form as to prevent clogging by dirt or dust and never requires cleaning or repairing. The position of the rivets through the opening G is shown at *b* and *d*.

Fig. 4 is a diagram of the lamp showing the carbons separated, as when the lamp is not burning. When the current is switched on its only path is through the fine wire magnets which at once draw up the armature A, slowly lowering the clutch and rod until the carbon points come in contact. If the trimming of the lamp is regular the carbon points will touch before the clutch releases the rod, consequently the carbons cannot lap, (a common trouble with constant potential lamps) for the instant the points touch, a path for the current is closed through the coarse wire magnet D which attracts the armature B, overcomes the pull of the fine wire magnets and lifts the clutch which again separates the carbons and establishes the arc. The pull of the fine wire magnets is constant and the strength of the coarse wire magnet varies with the resistance of the arc as they are in series. As the carbons burn away the resistance of the arc increases, and consequently the current flowing through the coarse wire magnet decreases until the fine wire magnets overcome its pull and slowly lower the carbon rod, thus maintaining a constant arc until the clutch trip reaches the plate C and releases the clutch. This allows the carbon rod to slide downward a little, but it is instantly caught and raised by the clutch as the carbon points come nearer and allow increasing current to pass through the coarse wire magnet. When the carbons have been consumed, the circuit is opened at the arc of the first pair of carbons that can feed no more, and the carbons in the other lamp that are not yet consumed continue to touch and spark slightly, thus indicating that it is the dark lamp which needs trimming.

The lamp, complete, is shown in Fig. 5. It is simple both in design and construction and pleasing in appearance.

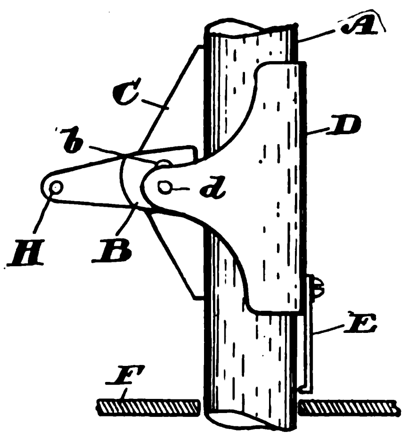


FIG. 1.

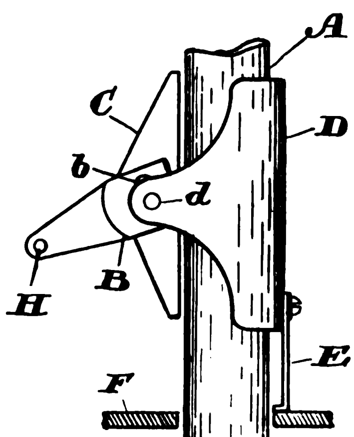


FIG. 2.

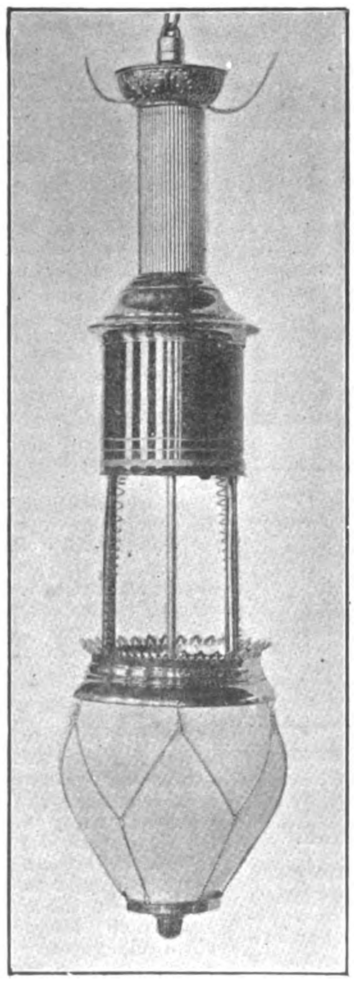


FIG. 5.

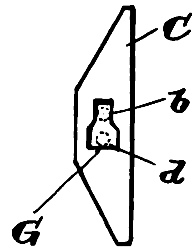


FIG. 3.

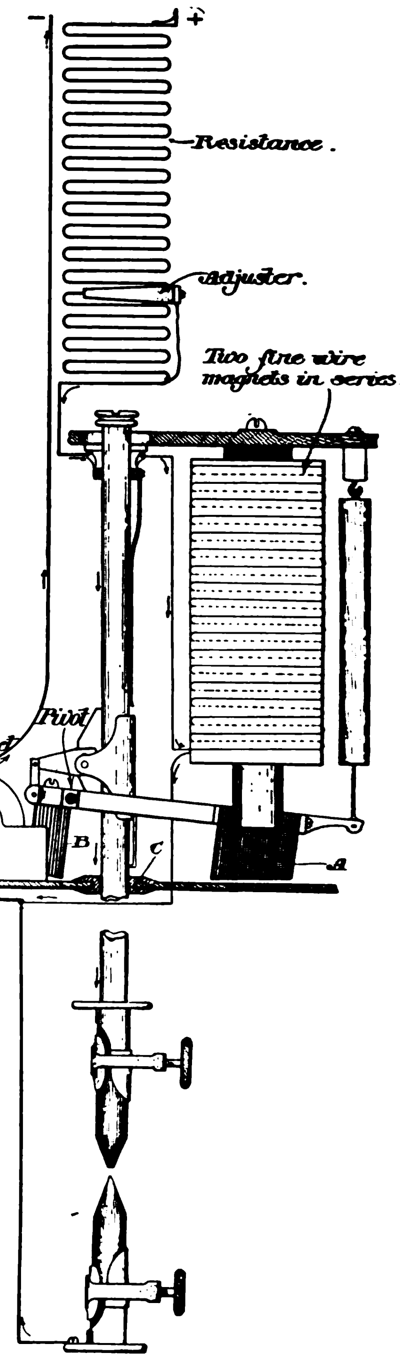


FIG. 4.

BRISTOL'S RECORDING AMPERE METER.

The accompanying engraving, Fig. 1, illustrates a new recording amperemeter just brought out by The Bristol Company, of Waterbury, Conn. This instrument, in connection with their recording voltmeters and wattmeters, which are already well known, makes it possible to keep a continuous record day and night, of the output of an electric lighting or power plant.

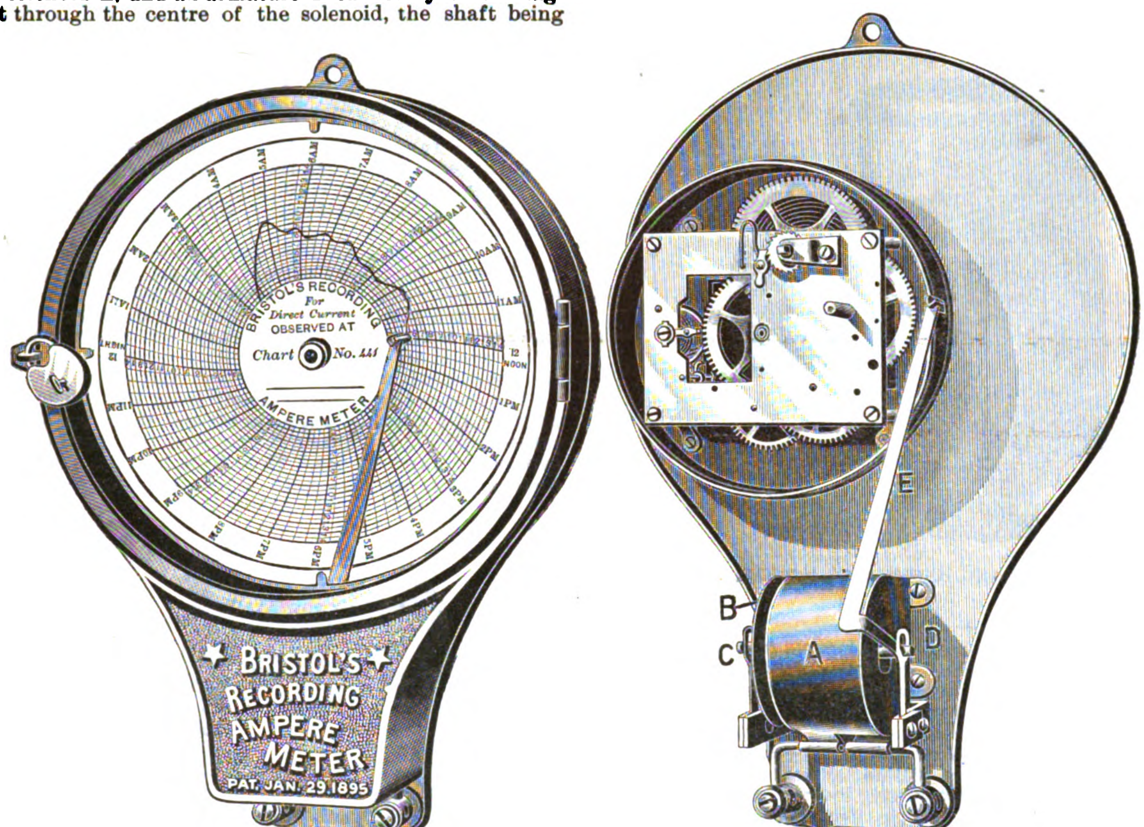
The general design of this instrument is clearly shown in Fig. 2, an interior view, from which it will be seen to consist of a stationary solenoid A, and an armature B carried by a non-magnetic shaft through the centre of the solenoid, the shaft being supported at its opposite ends on steel knife-edge spring supports C and D, the same as in the Bristol's recording voltmeter.

The recording pen arm E is secured directly to the steel spring support D, and partakes of its angular motion as the armature is attracted to the coil or solenoid by a current passing through the solenoid. Although the actual distance that the armature itself moves is small, it will be observed that it transmits an angular motion to the pen arm, resulting in a wide range on the chart without employment of multiplying devices between the spring and the pen.

A novel feature of this instrument is the form of armature which is used to procure a chart with the divisions nearly uniform throughout its range. It consists of two parts, a flat and very thin disc of iron and a small sleeve or core of iron on a non-magnetic shaft. The sleeve is completely concealed from view within the solenoid; the disc is stiffened by a plate of non-magnetic metal.

A moment's consideration will show that if the armature consisted simply of the flat disc portion, the magnetic attractive force would increase very rapidly as it approached the solenoid, giving a chart with divisions as in the Bristol's recording voltmeter, that is, contracted at the lower portion on the scale but very open at the upper portion; while if the armature consisted only of the core portion, the attractive force upon it would decrease as it approached the central or neutral position of the solenoid, and the divisions for the lower portion would be quite open, becoming contracted at the upper portion of the scale. After considerable experimenting a combination disc and core armature has been found which produces the nearly uniformly divided scale as shown in the specimen section of a chart, Fig. 3, for a range of fifteen amperes.

The armature and moving parts are reduced to a minimum in size and weight to avoid magnetic lag and the effect of the inertia, when current is thrown off and on. To provide for cases where there are extremely rapid and large fluctuations in the current to be recorded, as for example on an electric railroad, a damping device is provided, which consists of a vane of aluminum, secured to the left knife edge spring and immersed in a vessel of glycerine. For low ranges the solenoids are designed to carry the entire current, but for high ranges shunts are provided.



FIGS. 1 AND 2.—BRISTOL'S RECORDING AMPEREMETER.

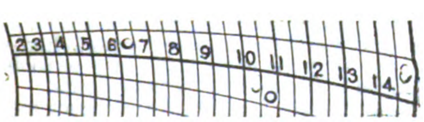


FIG. 3.—SCALE OF BRISTOL'S RECORDING AMPEREMETER.

ELECTRIC CRANE WANTED.

The Culver Stone Co., of Springfield, Ill., write that they are in the market for an electric traveling crane of 25 tons capacity. The tracks upon which the crane will travel are already in place. The crane wanted must have a 50-foot steel span with end trucks, trolley and the necessary electric motors to operate the trolley on the bridge, the bridge on the trams, and to hoist and lower loads of 25 tons.

"ELECTRICAL CONTRACTORS."

There are many sorts of "Electrical Contractors." A specimen of one sort advertises as follows in a paper that shall not be mentioned here:

JOHN DOE

ELECTRICAL CONTRACTOR.

Hardware and House Furnishing Goods.

Cor. —— and —— Sts. . . . ——

A full line of Stable Supplies, Horse Blankets, etc.

"THE BEST." A reader in Wisconsin in renewing his subscription writes us: "I find THE ELECTRICAL ENGINEER is the best electrical paper I ever subscribed for."

THE ECONOMIC REGULATING SOCKET.

The Electric Company, 56 Broadway, New York, have perfected and put on the market a regulating socket for incandescent lamps by means of which the amount of light can be graduated from full candle power down to a mere glow.

In addition to the comfort and convenience to be derived from the use of this socket in private dwellings, hotels, hospitals, steamships, etc., it affords the consumer a saving at the meter which amounts to as much as 69 per cent. at the last point of contact, and the life of his lamps is prolonged, because the sudden strain on the filament is avoided.

The socket, which will be known as the "E. R." (Economic Regulating) socket, does not differ materially in size or appearance from the ordinary non-regulating sockets of standard make, as will be seen from the accompanying illustration, which is life size. Its high economy has recently been tested and proved by professors at Columbia College.

THE ECONOMIC REGULATING SOCKET.

The "E. R." socket has been tested and endorsed by some of the highest authorities in the country, and being founded upon scientific principles, will, it is claimed, stand years of ordinary usage. It is one of the easiest sockets to wire ever made, and is said to be the only regulating socket ever placed on the market that is adapted to either the direct or alternating currents.

At a lecture on electricity before the Quill Club last week, by Mr. T. C. Martin, of THE ELECTRICAL ENGINEER, this socket was employed successfully as one of the illustrations.

THE "IRON CLAD" AMMETERS AND VOLTMETERS.

RECOGNIZING the demand that exists for a moderate priced well made, neat and reliable line of ammeters and voltmeters for switchboard use and that this demand is but insufficiently met at present, Messrs. Elmer G. Willyoung & Co. of Philadelphia have brought out the instrument illustrated in the accompanying engravings. Work on this instrument has been going on for a number of months and a large number of experiments have been made in order that the best results might be secured.

FIG. 1.—THE "IRON-CLAD" AMMETER

These instruments are circular in pattern with face 6 inches in diameter and the working parts are enclosed in handsome nickel plated cases of bold design. The instrument is of the soft iron type and is controlled by gravity, no springs or permanent magnets being used; the indications are thus permanently reliable and unchanging. The proportions of the soft iron parts have been carefully worked out experimentally so that the error due to residual magnetism is exceedingly slight. The scales are drawn upon white enameled metal and each instrument is individually calibrated by comparison with an accurate standard. In the ammeters the scale divisions begin at about 10 per cent. of the maximum range and are, for the rest of the scale, practically uniform throughout. In the voltmeters the first half of the scale is entirely suppressed while the remaining divisions are spread out so as to have as large a value as possible at and about the normal voltage.

The cases being of iron, the instruments are not affected by neighboring fields and currents but are "iron clad" in the best sense of the word, so that two instruments can be mounted very close to each other upon the switchboard without disturbing one another's indications. These cases are made with very tight joints which are closed inside with a composition cement so that the instruments are water-proof and dust-proof.

The connections, as is evident from the illustrations, are all made at the back of the switchboard, there being absolutely no projections of any kind on the front of the instrument to mar its symmetrical appearance. These back lugs are, in the case of voltmeters, brass spindles with double nuts for clamping the voltmeter wires. In the ammeters the spindles are very massive and carry at their ends similarly massive terminal lugs—these latter being bored out so that the main leads may be soldered to them which are clamped to the spindle by heavy nuts.

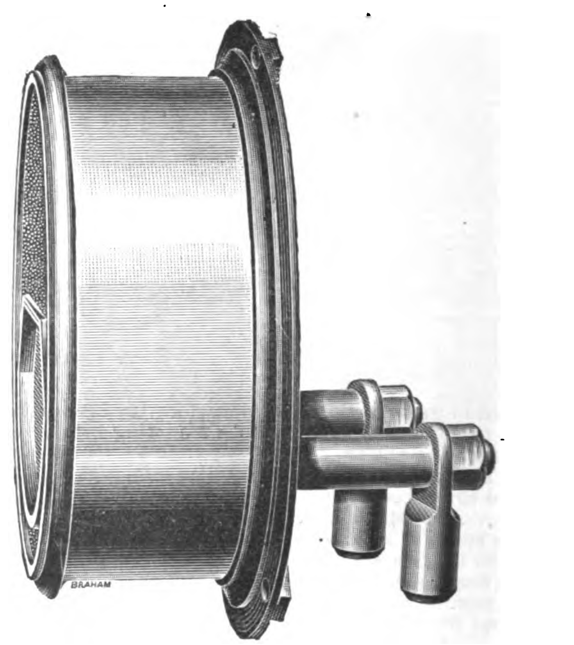


FIG. 2.—THE "IRON-CLAD" AMMETER.

These instruments are made both for direct and alternating currents (of any frequency), the instrument being calibrated to the particular frequency desired. Thus far these instruments are made in ranges up to 250 volts and 500 amperes. Tools are now being made for this same style of instrument but with cases 9 inches in diameter for use in large central station practice; it is expected that these 9 inch instruments will be ready about the middle of April.

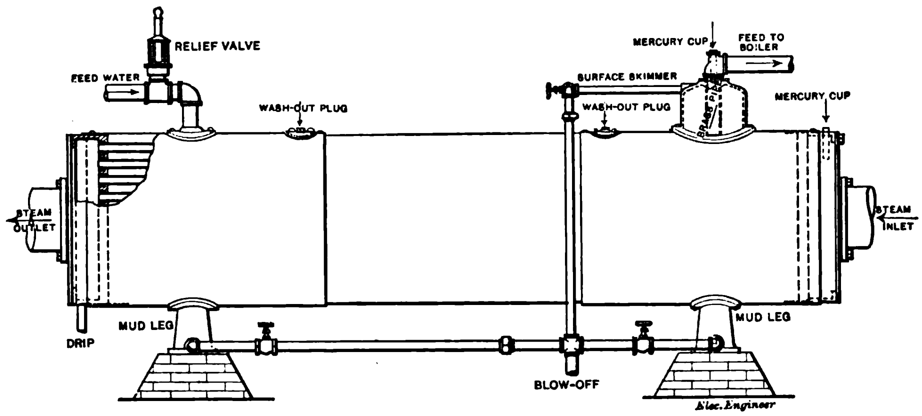
An especially noteworthy feature of the "iron clad" instruments is the exceedingly high insulation which has been attained. This is accomplished entirely by the use of plenty of hard rubber and the instruments are guaranteed perfectly satisfactory on circuits of two and three thousand volts.

These instruments are claimed to give permanently accurate indications within less than 2 per cent. maximum error.

Interested parties should write to the above mentioned firm for circular No. 101 containing prices and more complete details.

THE MORSE HORIZONTAL COPPER TUBE FEED WATER HEATER AND PURIFIER.

The accompanying illustration shows the Morse horizontal copper tube feed water heater and purifier, introduced by Messrs. C. O. Clark & Co., of the Mutual Life Building, Tenth and Chestnut streets, Philadelphia. A number of important advantages are claimed for this device, some of which we enumerate. In the first place, it can be blown out, washed out, and filled up without stopping the engine. Every part is accessible without a ladder, and there are no plates, pans, or heads to remove, no filtering substances to put in or take out, and the facilities for cleaning are unusually good, while the combined area of tubes is greater than the area of the exhaust of the engine, which precludes the possibility of back pressure.



THE MORSE HORIZONTAL COPPER TUBE FEED WATER HEATER AND PURIFIER.

The steam and water do not come in contact, hence no grease from the engine can enter the boiler, and the chances of explosions of boilers are reduced by having them clean. Only a portion of the exhaust steam is used so that the remainder can be utilized for heating buildings or any purpose for which exhaust steam may be required.

In the construction of the Morse heater and purifier the best seamless drawn copper tubes are used and these are free at both ends to expand in accordance with the temperature communicated by the exhaust steam passing through them, and owing to the form of packing, the tube-heads are relieved from all strains due to such expansion and the absence of leakage secured, which cannot be guaranteed where tubes are expanded into the heads. There is no shell to remove in case of having to replace a tube from any cause, and no expert labor required to do the work. All surfaces exposed to the action of the water of condensation from the exhaust steam are either of copper or cast iron. The surface for precipitating the impurities is the entire length of the heater, and hence is claimed to be much greater than that of any vertical heater where the precipitating is on the diameter of the tube-head only for the same purpose. But one pump or injector is required and the water does not require straining before entering the boilers. It is entirely self contained and has done good service in twenty-four states, besides Canada and Mexico.

ARC LAMPS—COREY—BERGMANN—KNIGHT.

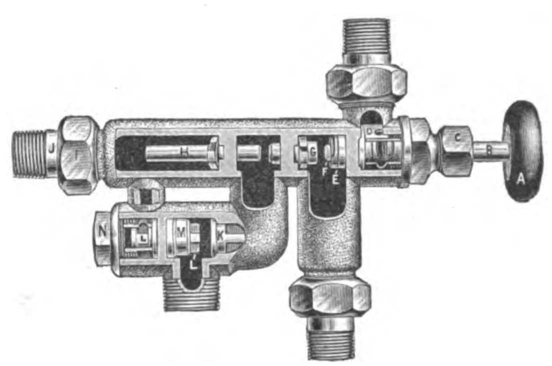
Mr. R. B. Corey has made an arrangement with the General Incandescent Arc Lamp Co., S. Bergmann, President, to manufacture an entire line of Knight Arc Lamps; under this management Mr. Corey is to be the exclusive Sales Agent for the Knight lamps and for the Bergmann lamps.

This combination of the adequate manufacturing capacity of the Bergmann works and the skill and experience of Mr. Corey in marketing goods promises well for the interests of both parties as well as of the purchasing public.

THE "INTERNATIONAL" PENBERTHY INJECTOR.

The accompanying illustration shows the "International" Injector, a new departure, which, it is claimed, combines all the good features of both automatic and positive injectors. The principal new feature in the "International" is that the current of water to the boiler is established against atmospheric pressure instead of against direct boiler pressure. This is accomplished by the combination of the overflow valve K and pressure valve L. When the injector starts, the steam, passing through the steam jet F and suction jet G, passes down through the overflow chamber, forcing the valve K and L away from their seats and opening the passageway through the overflow for the escape of steam, which by its pressure against the valve H holds both valves away from their seats. A vacuum being created between jets F and G, the water is lifted, and passing through the suction jet G and combining and delivery jet H on its way to the boiler, passes down through the secondary overflow, and out through the passageways between pressure valve L and pressure valve collar M. As the pressure increases in the delivery chamber around the delivery jet H, valve L is gradually forced to its seat against the collar M, but does not finally close until the current to the boiler is firmly established. The valve K in the meantime is closed by the vacuum in the overflow chamber. By a new construction of the parts in the steam chamber, the same valve handle A opens the valve admitting steam to the injector, and at the same time regulates the amount of water supply; therefore, no valve is required in the suction pipe, nor is one necessary in the steam pipe except as a convenience should it be desired to remove the injector at any time while carrying steam on the boiler.

Another new feature is the fact that the combination and



THE "INTERNATIONAL" PENBERTHY INJECTOR.

delivery jet H has no spill holes. The parts are made interchangeable, and are all easily accessible for cleaning, and the injector is fully guaranteed. It is manufactured by the World Specialty Co., of Detroit, Mich., who will send descriptive circulars and price list to any one inquiring for them.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 95th meeting of the Institute, will be held at 12 West 31st Street, New York City, on Wednesday, March 20th, at 8 P. M.

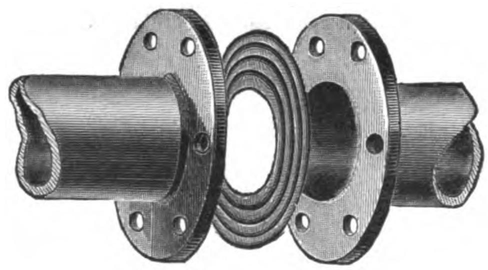
A paper will be presented by Professor Harris J. Ryan of Cornell University and Mr. Milton E. Thompson, entitled, "A Method for Preventing Armature Reaction." A meeting of Western members will be held the same evening, Wednesday, March 20th, 8 P. M., at Armour Institute, Chicago, where the above paper will be read by Professor Fortenbaugh of the University of Wisconsin.

ACADEMY OF SCIENCES.

ON Monday March 25, Prof. M. I. Pupin of Columbia College will deliver a lecture before the Academy of Sciences on "The Tendencies of Recent Electrical Research." The lecture will be held in Hamilton Hall, Columbia College, corner of 49th St. and Madison Ave., and all interested are cordially invited to be present.

A CORRUGATED COPPER GASKET.

The accompanying illustration shows a corrugated copper gasket for connecting steam, air, gas and water pipes, cylinder heads, steam chests, etc. It is being introduced by the U. S. Mineral Wool Co., of No. 2 Cortlandt street, New York, and may be used in place of rubber or other destructible materials in general use for packing. It consists of thin sheet copper, stamped with concentric corrugations. Three to six corrugations are all



CORRUGATED COPPER GASKET.

that are necessary, so that the space within the bolt holes usually determines the width of the gasket.

It is claimed that connections made with these gaskets will not blow out after continued use, for each corrugation makes the entire circle of the flange, and so long as the contact is kept complete by compression the joint cannot leak. This gasket can not blow out and may be put in place while steam is leaking through the valve. It also answers well on pipes in which steam is alternately on and off, for it is not impaired by the repeated expansion and contraction.

THE BOUDREAUX DYNAMO BRUSH.

SOME time ago we made mention of the Boudreaux dynamo brush which had met with marked success abroad, and we are now enabled to announce its introduction into this country. The Boudreaux Dynamo Brush Co. has opened offices in the Postal Telegraph Building, 253 Broadway, this city, in charge of the General Manager, Mr. Hugo Benedix, with branch offices in Chicago, and is now ready to fill all orders for brushes ranging in thickness from 1/16 to 1/2 inch and in width from 3/8 to 3 inches.

The Boudreaux "foliated" brush, it will be remembered, is made of anti-friction metal rolled into sheets 1/1000 inch thick and folded and refolded until the desired thickness is attained. It differs essentially therefore not only in the material but also in the manner of its application from the old "laminated" brushes. Besides its anti-friction properties the Boudreaux brush also possesses in an eminent degree the non-sparking property so that it preserves the commutator from wear, leaving it with a smooth and polished surface. A detailed price list will be furnished on application for sizes from one-sixteenth to one-half inch thick, and all seven inches long. Special sizes will be made up when desired.

THE IMPROVED BALL SYSTEM OF ARC LIGHTING.

DURING the past year the Ball Electric Light Co., of this city, have devoted their best efforts towards developing to the highest standard of perfection their arc light system in all its details. The success which has crowned their efforts is well shown in the description we give on another page of the new Ball automatic dynamo, which embodies a number of valuable features of distinct novelty reflecting much credit on the ingenuity of Mr. R. E. Ball, its designer.

This type of machine has been in active operation for the past year in a number of stations giving the utmost satisfaction, among them in the following places: Long Island City Elec. Ill. Co., Long Island City, L. I.; Village of Swanton, Swanton, Vt.; Standard Light & Power Co., Montpelier, Vt.; Wamsutta Mills (three dynamos), New Bedford, Mass.; Palmer Mills, Three Rivers, Mass.; E. O. Partridge, Taura, Iowa; Campbell & Smith, Pittsburg, Pa.; Hartford Electric Light Co., Hartford, Conn.; West Chicago Light & Power Co., Chicago, Ill.; E. O. Partridge, Osceola Iowa.; Skilton and Sons, Maracaibo, S. A.; John Karr, Flemington, N. J.; Jamaica Elec. Light & Power Co., Jamaica, L. I.; E. D. Hillman, Cambridge, Ill.; Buffalo Bill's Wild West Show, two portable plants. We may add that Ball machines of the old type can be readily changed over to the new automatic arrangement.

A marked improvement has also been effected in the Ball arc lamp. In the new type of out-door lamp the side rods have been strengthened and are heavily japanned; all exposed screws are made of composition instead of iron, the use of which resulted in frequent rusting and breaking. There has likewise been an improvement in the automatic cut-out; indeed, not only in lamps and dynamos but in every incidental detail, all possible improvements that experience could suggest have been effected.

The Ball company have also introduced a single carbon all-night lamp of simple construction, which offers all the advantages of the double, triple or disc lamps without their complications. They now manufacture a simple arc lamp of the rack type, every movement being direct and positive and dependent upon the two natural forces, magnetism and gravity, without the use of a dash-pot or spring of any kind. These lamps are made of any candle power and capable of running upon any constant current or constant potential circuit. The company is now also engaged in the manufacture of an enclosed globe lamp of fanciful and attractive design adapted to show windows, etc.

H. G. McFADDIN & CO.

A very handsome catalogue has been issued by Messrs. H. G. McFaddin & Co. of 38 Warren street, New York city. It consists of twelve plates 12 x 14 inches showing the various styles of glass globes for electric, gas and kerosene lights. The cuts are half tone photographic reproductions of the actual articles, and are beautifully executed and printed. The most striking feature of the book is the colored plate in two printings showing different styles of green shades, some of which have ground glass bottoms, for enclosed lamps.

WESTERN NOTES.

THE PENBERTHY INJECTOR CO., of Detroit, Mich., report that their new water gauges, oil cups, etc., are meeting with so great a success that they are several weeks behind their orders, and have been compelled to increase their force since the 1st of January. They expect to make another increase in working force in a few weeks.

MORRIS & McCURDY, of Indianapolis, are pushing the sale of their Phoenix rubber insulating paint of which they are sole manufacturers; and their card folder enumerates a variety of points in its favor. There is a good deal of curiosity to know what is the "newly discovered valuable mineral" which is "rich in natural oils" and constitutes the heart of the novelty.

NEW ENGLAND NOTES.

THE MATHER ELECTRIC COMPANY of Manchester, Conn. report the sale through Messrs. H. B. Coho & Company, of the Mail & Express Building, New York City, of one 350 light and one 330 light improved Mather ring type dynamos for the new lighting plant of the Portland Apartment House Washington, D. C., Messrs. Coho & Company having been awarded the contract for the entire plant including McIntosh & Seymour engines, piping, fittings, etc.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed for the Hartford & West Hartford Horse Railway Co. a new truss bridge, 186 ft. long, over the Farmington River, at Farmington, Conn. The new boiler house for the Stanley Rule & Level Co. was designed by the Berlin Iron Bridge Co., of East Berlin, Conn. The side walls are of brick, the floors of iron and the roof of iron, covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

THE PERKINS ELECTRIC SWITCH M'F'G CO., of Hartford, Ct., have a large force of men at work preparing their incandescent lamp factory, and expect in about a month to be able to fill orders. The factory for this purpose has been built for several months, but actual preparation for the manufacture of incandescent lamps had been suspended pending the Bate decision; but in a very short time all will be in working order, and an incandescent lamp factory embracing the most modern improvements may be expected. The Perkins Co. are also busy on their regular line of specialties, such as sockets, switches, cut outs, &c., and are having a great demand for the Waterhouse-Gamble incandescent arc lamp.

NEW YORK NOTES.

WALLACE & SONS, 29 Chambers street, have just issued their 1895 catalogue of their numerous brass and copper products. They carry a large line in New York, and their store is in direct telephonic communication with the large works at Ansonia. The catalogue is a book of nearly 100 large pages, and gives detailed information as to goods in roll, sheet, wire, tube, etc., as well as a great variety of detail material.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XIX. MARCH 27, 1895. No. 360.

THE LOGANSPORT MUNICIPAL LIGHTING PLANT, COMBINING WATER AND STEAM POWER.

BY CARL KAMMEYER.

LOGANSPORT, Ind., the county seat of Cass County, is a thriving city of about sixteen thousand inhabitants, situated at the junction of the Eel and Wabash rivers. Up to last December the city was paying a local lighting company $10,000 per annum for 100 street lights of 2000 C. P., operated upon the moonlight schedule. The question of the city owning and operating its own plant had been discussed for the past five years, but it was not until the the summer of 1893 that the matter began to take definite shape, with the result that last December the city's plant was started and as far as can be judged within the short time that it has been in operation, bids fair to prove a profitable venture on the part of the city.

When it was finally decided that the city should own its lighting plant, the council committee that had been given charge of the matter found itself confronted with what seemed at first sight grave obstacles in the way of ever operating a plant of that kind in a profitable manner. The city, owning the water power which had been furnishing the power for the city water works for years, that power naturally suggested itself as the most desirable, principally on account of the low cost. Just before the Eel river enters the Wabash, the former has a natural fall of about six feet with a width of about four hundred feet. A six foot dam increases the maximum fall to 12 feet, but it is only during about five months of the year that the maximum power is available, during the dry season the head often falling as low as eight feet. It was therefore decided to build a combined water and steam power plant, both of equal capacity, so that the plant could be operated, if necessary, entirely by steam.

The Station Building, a view of which is shown in the engraving, Fig. 1, is a substantial brick structure, T-shaped, the dynamo and engine room being 72 x 96 feet, and the boiler room 40 x 80 feet. The entire floor space of the main building is taken up by the turbines, electrical apparatus and engines, with the exception of a corner 24 x 30 feet, which is partitioned off and serves as a store room and office. Above the stone foundation walls, 12 inch brick walls with 18 x 24 pilasters are carried to a height of 20 feet to the roof, which is supported by 12 wooden trusses, having a 72 foot span. Rafters are laid

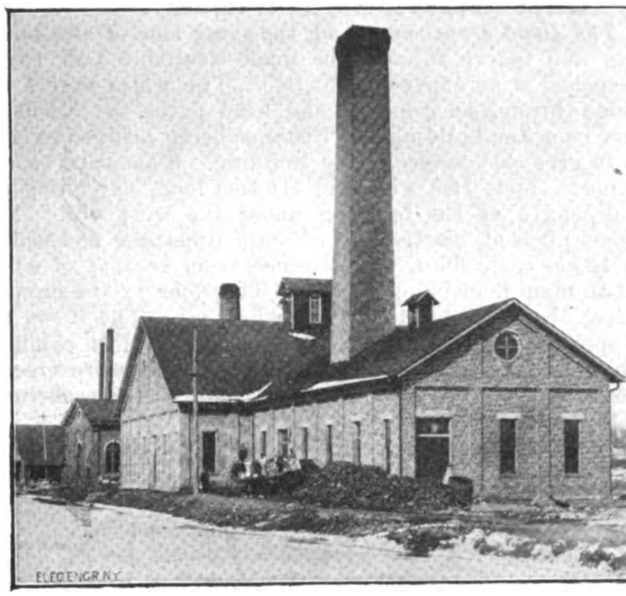


FIG. 1.—POWER HOUSE, LOGANSPORT, IND., MUNICIPAL LIGHTING PLANT.

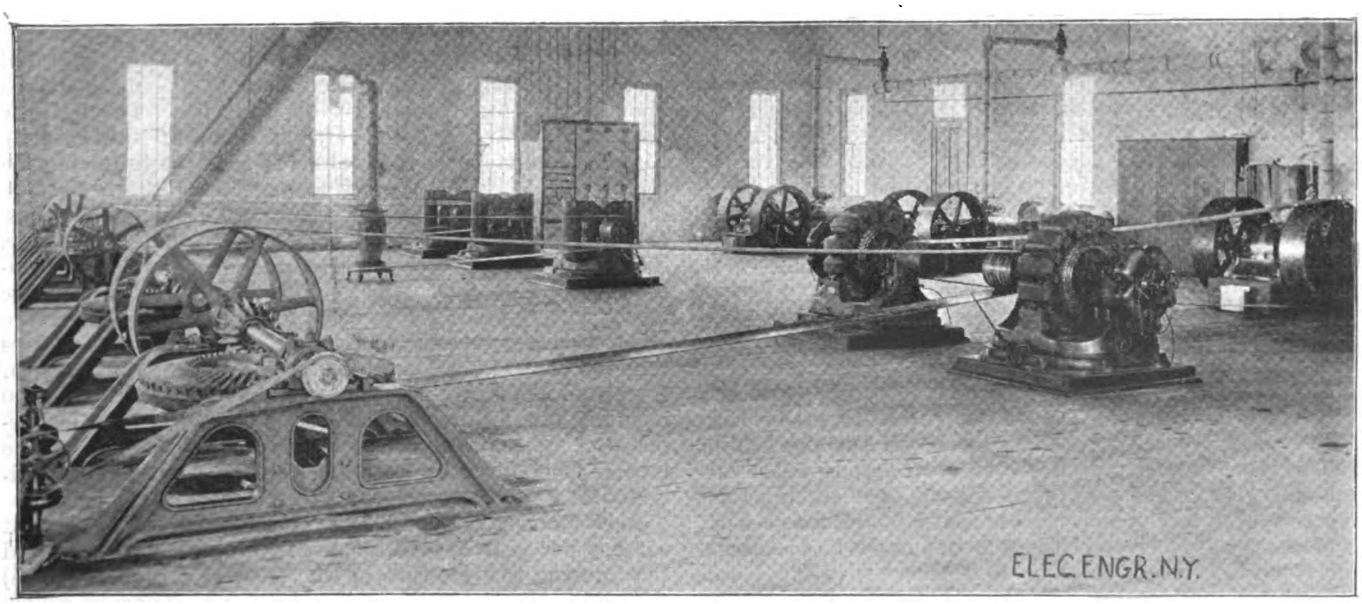


FIG. 2.—DYNAMO, TURBINE AND ENGINE ROOM, LOGANSPORT, IND., MUNICIPAL LIGHTING PLANT.

directly on the trusses at right angles to the principal rafters, and the sheeting is therefore laid with the slope of the roof. The sheeting is dressed on the inner side and painted white, the outside being covered with tin. But little trouble has been experienced from condensation naturally expected with an arrangement of this kind. A wire tower, 8 x 12 feet, ten feet high, is located in the centre of the roof and is large enough to receive the several circuits without crowding. In the centre of the boiler room a brick stack, 6 x 6 feet inside and rising with a slight taper to a height of 90 feet is ample to accommodate the present and future boiler capacity.

The Head Race runs along the south side of the building, and before it could be made available had to be deepened at an expense of $4,000. The water enters the flume through an iron rack and head gates, set about 15 feet from the building, the distance being bridged over so as to give easy access to the building. The water wheel flume is thirty feet wide and 112 feet long, extending the full length of the building under the west side. The wheel pit is all blasted out of solid limestone and walled up to the main floor, the distance from bottom of wheel pit to main floor being 21 feet. The floor in the flume is 8 feet above the bottom of the wheel pit. The floors are supported on steel I-beams, supported by iron columns. The building and water power equipment were erected from the plans and designs of Mr. Thos. J. Obenscheim of Wm. Dolan & Co.

The Turbines.—These are located along the west side of the dynamo room, and are all of the Improved Little Giant type, made by Wm. Dolan & Co., of Logansport. The equipment at present consists of four of their newly designed improved cylinder gate wheels; two 48-inch turbines, rated at 130 H. P. each, at 84 revolutions and three 36-inch, giving 70 H. P. each at 112 revolutions, an average head of ten feet being assumed in each case. Each turbine is geared to its line shaft in the ratio of 1 to 4. The gearing and bearing standards are of a neat and substantial pattern and were all especially designed for this plant. Standard ring-oiling, ball and socket bearings are employed. Each wheel is also fitted with an improved Woodward waterwheel governor, furnished by F. W. Woodward, Rockford, Ill. The belting was furnished by the Page Belting Co., of Concord, N. H.

The Electrical Equipment consists of two 1,250 light "Standard" alternators and three 60 light 2,000 C. P. "Standard" arc dynamos, all furnished and erected by the Standard Electric Co. of Chicago, who by the way were the general contractors for the entire plant with the exception of the site and building, which were furnished by the city. The dynamos are symmetrically arranged along the centre line of the dynamo room, shown in Fig. 2, the alternators being belted to the larger turbines, while each of the smaller wheels serves to drive one of the arc dynamos. From the generators all wires are led under the floor to a neat three-panel marble switchboard fitted with all necessary appliances in the way of current and pressure indicators, switches, ground detectors, rheostats, etc. From the switchboard overhead conductors lead out to the wire tower, where each circuit is provided with lightning arresters before leaving the building.

The Steam Plant.—Along the east side of the dynamo room are located four Erie City centre crank automatic engines, having a combined capacity of 440 H. P. Three of the engines have 13″ x 12″ cylinders giving 65 H. P. All of the engines are speeded to 300 revolutions and take steam at a pressure of 110 lbs.

The engines are placed at such a distance from the dynamo that in changing from water to steam power or vice versa, it is merely necessary to shift the dynamo belt from one to the other, proper allowance having been made for the difference in diameters between engine and turbine pulleys. It is of course desirable that in either case the "pulling" portion of the belt be next to the floor; this necessitates reversing each dynamo in changing over, which is probably the only objection that could be urged against the arrangement, and is fully offset by its flexibility.

In the boiler room, are located five Erie City horizontal tubular boilers, 60″ x 16 ft. each, a 500 H. P. Erie City feed water heater and two Erie City boiler feed pumps, either pump being large enough to feed all the boilers at a piston speed of about 24 ft. per minute. The boilers are fitted with gas burners, natural gas being piped to the plant, but at present the city is burning coal, Indiana block coal being delivered to the station at $1.25 per ton. With gas furnished at 7½ cents per 1,000 feet it has been found that coal is slightly cheaper. The engine and boiler equipment was furnished by the Erie City Iron Works and at the test made by the city's consulting engineer, proved not only fully up to the guarantees made by the contractors, but in some respects even better results were obtained than were anticipated.

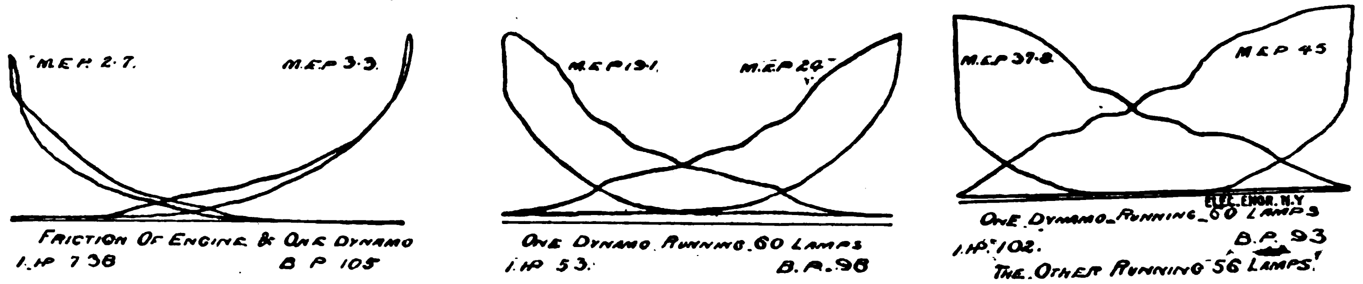


FIG. 3.—INDICATOR CARDS OF "ERIE CITY" ENGINES DRIVING "STANDARD" DYNAMOS.

The outdoor wiring consists at present of one incandescent and three arc circuits, the latter containing 34 miles of No. 6 weather proof wire. For the incandescent circuit a No. 00 feeder is run a distance of half a mile to a centre of distribution from which the lights are distributed through about ten miles of mains and branches.

Cost of Plant and Operating Expenses.—It was stated at the beginning of this article that the plant is looked upon as a paying investment by the city. Through the courtesy of Mr. S. B. Boyer, chairman of the Electric Light Committee, we are enabled to give the following details:

The total capacity of the plant, as constructed at present, will furnish 180 2000 C. P. arc lights and 2500 16 C. P. incandescents. The entire cost to the city in round numbers will be $60,000. One hundred and fifty of the arc lights will be used for street lighting, and will therefore bring no direct revenue to the city. The remaining 30 arcs the city will rent as commercial lights at $6 per month, giving an income of at least $2,000 per year. Of the 2500 incandescent lights it is expected that 1500 will be disposed of as commercial lights and 1000 for residences, the income at meter rates, 7 cents per kilowatt hour, being estimated at $14,000 per year, making a total of $16,000.

In estimating the operating expenses, which are given at $10,000 per year by Mr. Boyer, it must be borne in mind that during five months of the year (February to June) the entire plant can be operated by water power, which, as stated, costs the city nothing. Part of June and July one-half steam and one-half water will be used; July,

August and September all steam, and from that till January half steam.

In the $10,000 are included cost of coal, salaries ($600 per month), oil, carbons, incidentals and depreciation at 5 per cent. The management of the plant is under the direction of a council committee, appointed for that purpose. The salaried positions consist of 1 superintendent and electrician, 1 assistant electrician (dynamo tender), 1 engineer, 1 fireman and 2 trimmers.

Inside wiring for incandescent lighting is paid for by consumers, the city doing the work at a trifle above cost. Lamp renewals are paid for by consumers, the city selling 16 C. P. lamps at present at 30 cents.

Another source of revenue which the city has in contemplation is the establishment of a power service during the day, the conditions being exceptionally favorable for this, on account of the ease with which the combined power and lighting load, so troublesome in ordinary stations in the early evening hours, especially on dark winter days, can be taken care of in a plant such as described above.

Before the plant was accepted by the city, it was thoroughly inspected and tested by Mr. Frank B. Rae, retained by the city for that purpose. His report was extremely favorable and speaks well for the parties who furnished the several equipments. In speaking of the engine regulation, the report says: "A severe test of the governor was made by suddenly throwing off the lamps of the two arc light dynamos when under full load, thus throwing the engine suddenly on to a friction load only. Under these circumstances the speed of the engine increased only 4 per cent., decreased about 2 per cent. below normal and then rose to normal, the entire action having occupied but ten seconds."

The arc light dynamos are also favorably commented upon. The report states: "The machine ran remarkably cool. Readings of the thermometer taken after a four hours' run at full load showed a rise above the temperature of the atmosphere of 58.2 degrees Fahr. in the field coils and 62.2 degrees Fahr. in the armature, four minutes after stopping." The report concludes as follows: "The city of Logansport is to be congratulated upon the possession of an exceptionally fine arc lighting plant, which the city will be able to operate for a very much lower figure than can be done by contract, relieving the taxpayers of a very considerable burden."

As showing the regulation of the engine we reproduce three indicator diagrams, Fig. 3, taken under varying conditions of load.

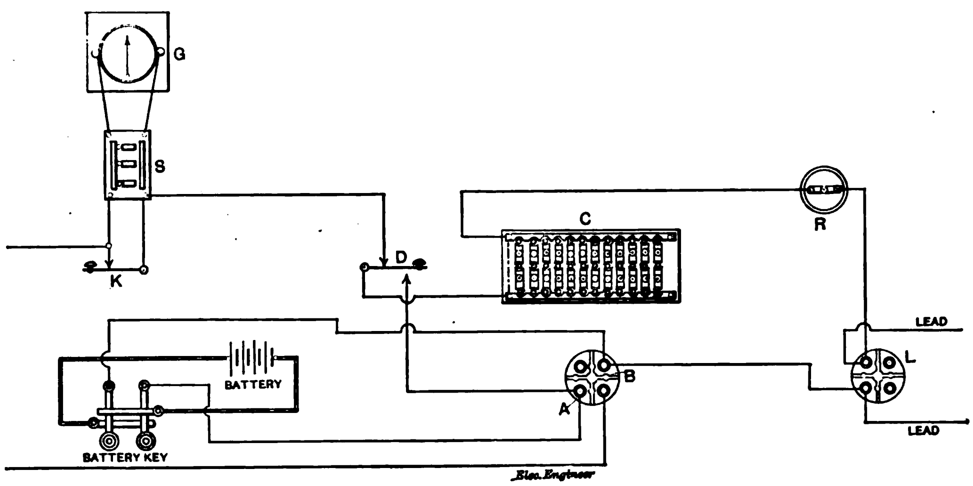
Now that the interest is so great in municipal plants, this description of one of the latest may prove of value to those who are investigating the subject under its many different aspects.

A HANDY CABLE TESTING ARRANGEMENT.

BY H LOEWENHERZ.

When it is required to make a large number of tests on bunched or other cable for capacity and insulation resistance, and valuable time is likely to be spent in disconnecting and re-connecting the instruments when changing from one test to another, one is naturally on the search for means whereby this time may be reduced to a minimum with the least chance of error. If possible all the instruments ought to be kept in one room, set aside for testing purposes, where there is the least chance for magnetic disturbances. Well insulated leads should be run from this room to where the reels of cable are situated and the proper connections made there. When the cables are 50, or 100-pair, they will take considerable time to test and when a large number, such as 6 or 7 reels, have to be tested in one day the method to be described below, due to Mr. A. C. Thomas, B. S., will be found very handy.

The scheme of wiring makes use of double plug reversers, which obviate the necessity of disconnecting, thus facilitating the quick operation of the tests. Mr. H. L. Webb, on page 76 of his little book entitled "Testing of Insulated Wires and Cables," describes an excellent method of wiring a permanent set of testing instruments.



Arrangement for Rapid Cable Testing.

The method to be described is somewhat similar to Mr. Webb's, but requires the use of plugs, except when testing for conductor resistance, when a Post Office bridge may be added and the wiring somewhat changed to suit.

Referring to the diagram, L is a set of double plug reversers to which are attached the leads coming from the cable to be tested; B is a 100,000 ohm resistance coil which can be short circuited by being plugged; D is a Webb discharge key; S a shunt box; G an astatic galvanometer; C is an adjustable multiple condenser whose sections may be connected in series or parallel. Transparent scale and mirror galvanometer are not shown in diagram. At A and B we have another double plug reverser, also a battery of 100 chloride of silver cells and an old form of battery reversing key. K is a key for short-circuiting the galvanometer. To take the insulation constant, L and A are plugged, and the condenser C across the first bar, leaving up discharge key D, short-circuited. There is also put in circuit the $\frac{1}{1000}$th shunt. We have then in circuit $1000 \times 100{,}000$ ohms = 100 megohms. By putting on battery through battery key, deflections may be obtained to both sides of the scale by operating key K. Say, a deflection of 300 divisions is obtained through the 100 megohms; then 30,000 divided by the so-called insulation constant, will be the deflection for one megohm.

To make the insulation test, the sheath and all wires except the one undergoing test, are grounded, and proceed as follows. Leave D up, plug A and B, and short-circuit

condenser C. Now put on battery and after one minute's electrification depress key K and note the deflection. Repeat this operation for every wire. Suppose we get a deflection of 100. 30,000 was the deflection we got for 1 megohm, therefore 30,000 ÷ 100 = 300 gives us the number of megohms of insulation resistance. Of course, the deflection taken from the leads alone must always be subtracted from cable deflections.

When measuring capacity it is necessary to test each wire against every other wire and sheathing. The capacity test is taken by the substitution method. For taking the capacity constant, use about 30 to 40 cells, plug up R, L and B and open key K. Then arrange the multiple condenser so as to have $\frac{1}{100}$ microfarad capacity. Operate as follows: Key K being open, put on battery, push down key D and thereby charge the condenser; then release key D and discharge the condenser through galvanometer, noting deflection. This deflection multiplied by 100, will be the constant, that is, the deflection which would be obtained through 1 microfarad.

To obtain the deflection from cable, plug R, B and condenser C, then open key K. Put on battery and press down key D for about ten seconds, thus charging the cable. Now release key D, thus cutting off battery and closing the circuit through galvanometer, noting the deflection obtained. This deflection minus that obtained from the leads alone, divided by the constant, will give the actual capacity of the wire under test. The deflection from the leads should be taken before and after taking deflection from separate wires of the cable. The deflection from leads divided by the constant will give the actual capacity of leads in microfarads.

COVERED FUSE CUT-OUTS DANGEROUS.

BY WALTER E. HARRINTON.

The rules of the Boards of Fire Underwriters call for covered fuse cut-outs. The probable reason of such a requirement is based on the natural assumption that the "blowing" of a fuse if not entirely covered up will cause fire. The reason a fuse is employed is to protect, but experience has demonstrated that fuses rarely "blow" in practice under the conditions which have determined their rating. That is to say, the rating of fuses is based upon the minimum current causing fusion in the maximum time, and the usual condition in practice under which a fuse "blows" is such that an abnormal current flows through it before fusion occurs.

When a fuse "blows" under the conditions which have determined its rating, the phenomenon is one of very little manifestation; the metal simply melts quietly and drops. Consequently if a fuse be covered this latter behavior does not effect in any wise the action or result of the fusion, particularly so if the difference in potential be low, say, 50 volts. There is no question but that the observation of this latter method of fusion led to the adoption of the method of using covered fuse cut-outs.

The writer desires to put himself on record at this time in stating that the use of covered fuse cut-outs is radically wrong, as it is based upon practically wrong premises. As stated before, fuses rarely "blow" in practice under the conditions such as have determined their rating. The usual causes of fuses "blowing" are such as crosses, grounds and short-circuits. What ensues? The momentarily great flow of current which the fuse permits to flow through it during its fusion, causes the fuse to blow quicker, and the more severe the condition, the higher the voltage, the quicker the fuse blows; and the consequence is that a veritable explosion follows.

In 500 volt practice it is impossible to have a fuse "blow" under a short circuit in any of the commercial, covered fuse blocks without their destruction. Every fuse block manufactured and placed on the market for sale was recently subjected to short circuit tests in the power station of the Philadelphia Traction Co., and in every instance the lids were shattered and the terminals burned, and further, the circuit was opened by the switch board magnetic circuit breakers.

The blowing of a fuse under a short circuit in 500 volt work, when the fuse is open in the atmosphere is accompanied by a loud rifle-like explosive report. It is manifestly incorrect then to take this explosive medium and enclose it in a small space. The writer read a paper upon "The Destructive Arcing of 500 Volt Fuses" before the American Street Railway Association at Atlanta, Ga., in October, 1894. This paper dwelt upon the destructive and vicious character of the gases attending the blowing of fuses, and showed that the incidental troubles following the blowing of the fuse due to the gas could be worse than the damage incident to the flow of current, causing the fusion.

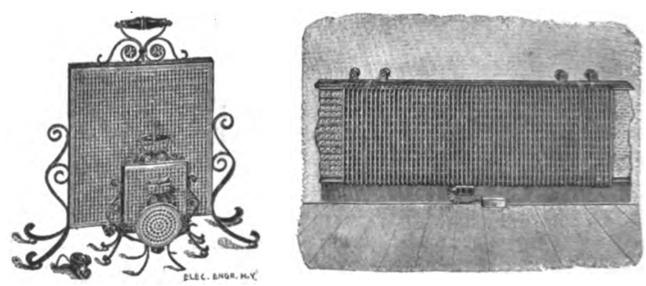
The sudden formation of gas in a closed fuse block under a short circuit condition is attended with the most severe results, as the gas is an excellent conductor and, being enclosed without free vent, the gas is at its maximum density and therefore minimum specific ohmic resistance, with the result that, while it is true, the fuse is disintegrated, still a most excellent flexible, floating conductor is present carrying current; further, this gas is maintained at the expense of the terminals and is a most fruitful source for fires.

The natural remedy is to provide fuse blocks, the fuse having free unobstructed vent to the atmosphere. Copper makes the best fuse metal, as it gives the minimum cross section of metal per ampere of any metal outside of silver. Make the length of fuse as small as possible, with the fuse having protected terminals such that when the fuse has "blown" the arc is killed by the protection on the terminals.

If protection outside of the fuse is desired against the vicious gases following the explosive blowing of the fuses, build a spacious box or closet for the fuse blocks to vent into, provided with proper ventilation and protected inside against fire. Experience shows that no dependence can be placed upon fuse metals as a protection on circuits carrying over 10 amperes, and that magnetic circuit breakers are the only means available for sure protection.

ELECTRIC HEATERS IN A LONDON THEATRE.

In a recent issue we commented on the steady progress in the application of electric heaters and instanced their installation in the Vaudeville Theatre, in London. After a preliminary trial that place of amusement has now adopted this type of heater to the exclusion of all others. The work was carried out by Messrs. Crompton & Co., Limited. The electric radiators are fixed around the skirtings on either side and along the front of the orchestra. These radiators are of "box" or "wall" form, that is, they have a front radiating surface studded with projections fixed into cast-iron boxes which are screwed by means of lugs and insulators to the walls and partition. Each box radiator Fig. 2 is 2 feet long



FIGS. 1 AND 2.—ELECTRIC HEATERS IN A THEATRE.

and 1 foot wide, and, therefore, offers a radiating surface of 2 square feet. The air is allowed to circulate between the casing and the wall so that an extra heating surface is obtained. There are six box radiators on either side of the theatre, and 12 attached to the partition in front of the orchestra. The latter are cased in at the back, and a good current of air is obtained by carrying the casing below the boxes containing the radiators. The four large portable radiators, Fig. 1, originally on trial are arranged for use, either in the stalls or at the sides. Four wall sockets are fixed, two on each side, and four on the chair supports in the centre of the stalls. By means of these connectors the radiators may be employed to warm the centre before the performance begins and afterwards removed to the sides. Each radiator, portable and fixed, has a safety connector, and can be detached from the circuit at will. The radiators reach the usual temperature of hot water pipes, and they are found to produce quite sufficient heat. The average temperature of the theatre inside after the radiators have been working a reasonable time is about 60° (*i. e.*, temperate) when the corridors are about 40°. Most theatres are subject to draughts from the frequent opening of doors and from the stage, but notwithstanding these the temperature at the Vaudeville is maintained fairly constant. Arrangements have now been made for warming the stage, and no doubt this will prevent the passage of the cold currents of air usually experienced when the curtain is raised. The current taken by each large portable radiator is 12 amperes, and the small box radiators take 3 amperes each, making in all a total of 114 amperes, but as only two of the larger radiators are found necessary the current actually used for warming the auditorium is 90 amperes at 100 volts. Thus it will be seen that 9 kilowatts per hour are required when the whole apparatus is in full work, and the cost at 8 cents per unit is 72 cents per hour. To warm the theatre, therefore, for a period of four hours the cost is $2.88. One distinct advantage makes elec-

tric heating far preferable to other systems, and that is the perfect regulation. Thus the whole or any number of the electric radiators may be put on or cut off at will, and there is no fear of overheating the theatre and making it uncomfortable at any time. No attention whatever is required with the electrical radiators, and any of the theatre attendants can turn the current on or off according to the requirements of the case. Owing to the fact that the radiators have not to be turned on until a short time before the performance begins, the state of the weather may be judged and the heat graduated accordingly. In comparing the up-keep of the electrical plant with hot water systems Messrs. Crompton state that the former will in all probability be considerably less than the latter, owing to the fact that there is no furnace to burn out, and no rusting or wearing out during long periods of disuse. Electric radiators are found to be very durable, they are not required to reach high temperatures, and they offer a large radiating surface. Electric radiators are so constructed that they cannot overheat themselves, they radiate the heat as freely as it is produced, and, as a consequence may be left to work without attention and in perfect safety. The cost of installing the electric heating apparatus at the Vaudeville has come out at about the same as for hot water heating, and, taking all into consideration, the electric system of heating offers many advantages over the older forms of heating employed, which would justify even a higher price. It may be stated that electric radiators are on trial at several other theatres and public buildings, in London, and in many places where other systems of heating are in use it is proposed to employ these radiators for temporary assistance in extra cold weather, or for use at a moment's notice when no provision has been made for warming the building in the usual manner.

TELEPHONE.

THE JACQUES LONG DISTANCE VIBRATING MICROPHONE.

It is well known that when a multitude of electrodes are maintained in loose contact with each other and an electric current of moderate strength is passed through them, these electrodes will remain normally at rest, and a telephone receiver connected in circuit will be normally silent. If, however, the strength of the current be increased, these electrodes will, at some definite strength of current, dependent upon the number and character of the electrodes and the normal pressure existing between them, break into rapid and continuous vibration to and from each other, and there will be heard in the receiving telephone a rustling sound made up of a multitude of simultaneous pitches.

Hitherto in the commercial use of multiple contact transmitters, of which the Hunnings transmitter may be considered the type, it has been customary to use a current which shall not be so strong as to set the electrodes in vibration. Whenever, either by accident or as an experiment, a stronger current has been used and the electrodes have been set in vibration, the telephonic system, consisting of the transmitter and its corresponding receiver, has proved less efficient in the transmission of speech, because the resulting noise due to the vibration of the transmitter electrodes, has acted upon the listening ear to make it less sensitive and therefore less fitted to receive and understand transmitted speech.

In a patent just issued to Dr. W. W. Jacques, of Newton, Mass., the inventor states that he has discovered that when a multitude of electrodes in loose contact are normally kept in a state of rapid and continuous vibration, they are much more sensitive to sound waves falling upon them than are the same contacts normally at rest. Though the discovery was in fact an accident, the explanation probably is that the resultant normal pressure existing between the various pairs of electrodes of a multitude of electrodes is less when all of the electrodes are in vibration to and from each other, than when they are at rest; and it is well known that, within limits, the sensitiveness of any microphone contact increases as the normal pressure is decreased.

A multitude of loose contact electrodes are kept in rapid and continuous vibration by passing through them a very strong electric current. Dr. Jacques uses a current from a low resistance battery (as, for example, a storage battery or standard Fuller bichromate battery) having an electro-motive force of about twenty volts. A much larger battery maintains the electrodes in too sensitive a condition for practical use.

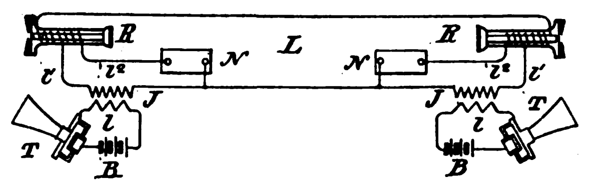
Dr. Jacques has further discovered that upon a long telephone line, undulations of current due to the vibrations of the electrodes of the transmitter produced by the normal action of the battery will fade out and disappear at a greater or less distance from the transmitter; while undulations of current due to the action of sound waves upon the normally vibrating electrodes will persist and the sounds be heard in the telephone at the distant end of the line.

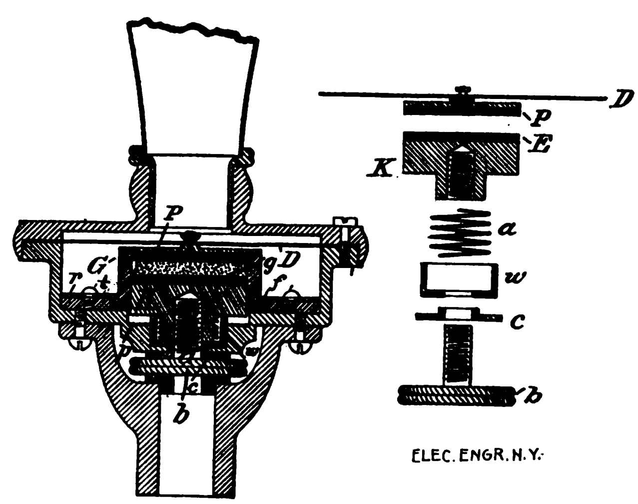
In the accompanying illustrations, Fig. 1 is a diagram, representing the apparatus as a whole; Fig 2 is a view of the transmitter in section, and Fig. 3 represents details of the same.

As will be seen the carbon particles are retained within a cylinder G, made of slate-stone or other fire proof insulating material having a small coefficient of expansion. It has a flange *f* and is secured to the interior of the cup-shaped frame by a brass ring *r* which rests upon the flange and is there held by screws screwing into the frame. E is the back electrode, being a disc of hard carbon brazed to a brass disc K, a projection from which lies, as shown, within a hollow projection *p* from frame F, the two projections being insulated from each other by a cup-shaped washer *w* of vulcanized fiber. P is the front or working electrode, being a disc of hard carbon rigidly secured to the sound receiving diaphragm D by a screw and nut as shown.

The two electrodes E and P fit the cylinder G closely. For a variable resistance material between them Dr. Jacques employs granulated carbon, *g*, the grains being of such size, varying from $\frac{10}{1000}$ to $\frac{38}{1000}$ of an inch in diameter, that they will not pass between the peripheries of the electrodes E and P and the inner wall of the cylinder G. These grains make the numerous loose contacts, which, in the operation of the instrument are kept in violent vibration by the strength of the battery current while serving also as the variable resistance medium between the working electrode P and the back electrode E, to take up the vibration due to local waves in the ordinary manner.

The back electrode E is made adjustable by means of a spring *a* tending to push the brass disc K into the cylinder G and a brass thumb screw *b*. A flanged washer *c* of vulcanized fibre insulates





THE JACQUES LONG DISTANCE VIBRATING MICROPHONE.

frame F from the thumb screw *b*. The frame F is in metallic connection with the working electrode P, while the thumb screw *b* is in metallic connection with the back electrode E.

In the operation of the instrument, it would seem that the notes or sounds due to vibrations of the loose contacts induced by the voice, find reinforcement or additional strength in similar notes or sounds due to vibrations set up by the strong battery and reach the receiver at the distant end of the line, while notes or sounds due to the battery alone fail to reach the receiver at the distant end of the line. The noise in the receiving instrument, however, resulting from the two sets of vibrations in the transmitting instrument at the same end of the line is not only painful to the ear but interferes with the proper reception by the ear of sounds coming from the other end of the line. To obviate this difficulty Dr. Jacques so constructs the receiving telephone that the current coming from the transmitting telephone at the same end of the line is divided and passes around the core of the receiving instrument in two directions, while the current from the transmitting telephone at the farther end of the line passes around the core always in one direction. This winding is shown in the diagram Fig. 1, where L represents the main line, *l* the local circuit and J the induction coil, from the secondary of which a wire l^1 leads to the core of the adjacent receiver R, about which, dividing, it is wound in two directions; one portion, wound in one direction, going to the main line L and by the main line back to the secondary of the induction coil, while the other portion, wound in the opposite direction, returns to the secondary of the

induction coil by wire l^2. A resistance N is placed in wire l^2 to equalize or vary, as may be desired, the proportions of the current passing through L and l^2. It may perhaps be advantageous to maintain a slightly imperfect balance in order that the user of the transmitting instrument may hear his own voice in the receiver.

TELEPHONE NOTES.

New Orleans, La.—S. P. Walmsley, Chas. H. Schenck, Wm. P. Nicolls and others have applied for a telephone franchise.

Bogue Chitto, Miss.—C. H. Trotter will construct telephone lines.

Natchez, Miss.—The Great Southern Telegraph & Telephone Co. may construct a line from Natchez to St. Joseph, La.

Brownsville, Tenn.—The telephone exchange for Brownsville is an assured fact.

Savannah, Ga.—Savannah is to have a new telephone company.

Readsboro, Vt.—Frank Crosier is to put in a telephone system at Wilmington.

Piqua, O.—The Miami County Telephone Co. has been formed; capital stock, $12,000.

Hannibal, Mo.—Hannibal will be connected with Spalding Springs by telephone.

Phillips, Me.—The North Franklin Telegraph Line will soon be changed to telephone.

Westminster, Md.—A company is being organized to establish a telephone system with a number of surrounding towns. Address R. B. Hazlett.

Milford, Mass.—Manager Donnelly of the telephone exchange is working hard to obtain for the benefit of Milford subscribers a direct through line to Boston.

Staten Island.—The Staten Island Automatic Telephone Exchange has been formed; capital stock, $50,000; incorporators, Athol B. Mackin, Joseph E. Pucci, James F. Duhig.

Calvert, Tex.—A move is on foot to connect this town with Franklin, the county seat, by telephone. The citizens are responding liberally and success is almost assured.

Palmyra, Mo.—Benjamin Moss, of Monroe City, and Thos. J. Suta, of Palmyra, have organized a company to establish telephone system.

Manistee, Mich.—A new telephone company using the Gilliland system, has asked for a franchise at Manistee. The stock is $15,000. The company is taking orders at exactly half the rates of the old company, and 300 subscribers are guaranteed from the start.

Utica, N. Y.—At a recent common council meeting the application of the Central New York Telephone and Telegraph Company for permission to construct underground subways for its wires and cables was granted.

Deposit, N. Y.—W. N. Cannon of Binghamton has made arrangements to put in a telephone system, with a fifty drop switchboard. About twenty miles of wire will be strung. The system will cost about $2,500.

Hartford, Conn.—A bill has been presented incorporating the People's Telephone Company for the purpose of operating telegraphic or telephonic communication and transmitting power in any part of Connecticut.

Prairie du Chien, Wis.—A telephone line will be built from Prairie du Chien to Boscobel via Wauzeka to Soldiers' Grove. The people of Viola are agitating the question and want the line extended to Viroqua via Viola.

Rockland, Mass.—The Southern Massachusetts Telephone Company is now constructing a line from Rockland to Scituate, and, as soon as that is done, will string wires from Scituate to Brant Rock and Duxbury.

Carthage, N. Y.—The International Telephone and Telegraph company, whose headquarters are located at Gouverneur, have obtained franchises for building and operating their lines in Antwerp, Carthage and Philadelphia, and they will open exchanges in those villages.

Atlantic, Me.—A charter has been granted by the legislature to H. W. Joyce, H. W. Small and H. P. Jones, of Rockland, to operate a telegraph and telephone line to run to both sides of Old Harbor, to Atlantic, to Orino island and to connect at Bass Harbor with the main land.

Manchester, Ia.—The Manchester Telephone company is the name of a new corporation which is being formed for the purpose of putting in a telephone system in this city. The incorporators, officers and directors of the company are A. A. Anderson, president; H. C. Haeberle, vice president; C. H. Day, secretary; R. R. Robinson, treasurer; A. Hollister, C. A. Peterson, and H. C. Smith. The authorized capital is $2,500.

Rangeley, Me.—The Rangeley Telephone Co. at their annual meeting elected the following officers: Moderator, J. R. Toothaker; directors, J. R. Toothaker, Whiting Butler and W. F. Oakes; secretary, H. A. Furbish; treasurer and superintendent, George M. Esty.

Peoria, Ill., is to have telephone competition. The International Telephone Construction Company has applied for a franchise which will probably be granted. The Harrison telephone will be used and rates will be about one-third those charged by the Bell Company.

Alexandria, La.—The Alexandria Telephone Company, Limited, with a capital stock of $2,500 has been organized here, work to commence as soon as $1,000 is subscribed and paid in. The following are the officers: Thomas Clements, president; J. C. Ryan, vice president; L. A. Stafford, secretary and treasurer.

Petersburg, Va.—A charter of incorporation has been granted to the Mutual Telephone Company, the company lately organized to furnish Petersburg with a cheaper telephone service. The capital stock is to be not less than $5,000 nor more than $25,000. The officers for the first year are: President, William B. McIlwaine; vice-president, E. A. Hartley; secretary and treasurer, Richard D. Gilliam, and a board of directors.

Belvidere, Ill.—The superintendent of the Central Union Telephone Company has been making contracts with the residents of Belvidere, agreeing to furnish telephones free. The contract calls for $18 per year, but when the contract is signed the subscriber is presented with a receipt for one year. Belvidere was one of the first towns in the country to put in an opposition telephone exchange, and this action on the part of the old company is intended to cripple the others.

NEW ELECTRICAL SIGNAL LIGHTS FOR THE WEATHER BUREAU, NEW YORK CITY.

On the night of March 6 were displayed for the first time the new signal lights of the Weather Bureau from the new quarters in the tower of the Manhattan Life Insurance Company's Building on Broadway. Several stories of the tower 350 feet above the street will be occupied by the offices of the Bureau, and above these, in the extreme top of the dome, are hung the signal lamps which will be used to indicate expected changes in the weather.

The signals consist of two sets or groups of General Incandescent Arc Lamp Company's 12 ampere arc lamps. Each group is arranged in a circle in the lantern of the dome, the upper circle consisting of six lamps and the lower of ten. The windows surrounding the upper group are of opal glass while those about the lower are ruby colored, and a partition separates the two groups and cuts off the rays of light from one to the other.

The lamps of the lower set are hung from two hollow brass rings with slots in their under sides and rollers within the slots which allow the lamps to be rolled out of the way without turning them off. This is made necessary by the limited space above the head of the circular stairway leading to the lantern. The lamps are controlled from a switchboard downstairs in the twenty-third story where a switch is provided for each two lamps, so that the intensity of the light may be regulated at will.

The New York Electrical Equipment Company, who put in the lamps and did the wiring for the Weather Bureau, are now at work upon a truck which will run on a track around the tower and carry a search light, after the manner of that at the Madison Square Garden, but of a later and better design.

THE PREPARATION OF TITANIUM.

M. Henri Moissan has recently succeeded in preparing titanium in a nearly pure state. This has hitherto been a matter of great difficulty. When the metal is prepared by the reaction of sodium or potassium on a haloid salt of titanium, the latter is always greatly contaminated, either by nitrogen—for which it has a great affinity, forming a definite compound—or with the sodium, potassium, or oxygen. The nitride of titanium is easily prepared in the electric furnace, in the form of a bronze-colored mass, by strongly heating titanic acid in a carbon boat, using a current of 300 to 350 amperes at 70 volts. With a lower voltage an oxide of titanium is formed. The temperature at which this nitride decomposes is exceedingly high; but by means of a current of 1200 amperes at 70 volts M. Moissan has succeeded in obtaining a carbide of titanium free from nitrogen, using for the purpose a mixture of titanic acid and carbon. By repeating the operation in a crucible, the carbon not being in excess, an ingot is obtained of which the upper portion is an alloy of titanium and the carbide of the metal. By mixing this with a fresh supply of titanic acid and reheating again in the furnace with a current of 2000 amperes at 60 volts, a purification of the metal is effected, and a sample of titanium containing only about 2 per

cent. of carbon is obtained. In this condition it is found to have a brilliant white fracture, and is said to scratch rock crystal easily. It is, however, brittle, and can easily be reduced to powder, but is the most refractory substance yet reduced by means of the electric furnace.

THE WALTER COMBINATION FIRE ALARM AND POLICE SIGNAL SYSTEM.

Protection against fire always has been and always will be an important question with municipalities and private corporations. Millions of dollars are annually paid by insurance companies for fire losses and millions are expended each year throughout the United States alone in maintaining fire departments and fire alarm systems. In the larger cities a well equipped and systematically operated fire alarm system can be maintained at a comparatively moderate cost, because the frequency of alarms makes it desirable, not to say imperative, to have a central office with an operator or operators in constant attendance. In the smaller cities, however, a manually operated fire alarm office is practically out of the question, and an automatic system must be employed in order to keep the expense of maintenance and operation within reasonable limits. A system of this kind, in order to satisfy the demands of smaller cities and corporations must first of all be absolutely reliable, it must also be comparatively cheap to install, and the cost of operation and maintenance must be reduced to the lowest possible figure.

With this point in view, Mr. H. E. Walter, of Richfield Springs, N. Y., has recently perfected a combined police and fire alarm system, which, however, can be used separately. The fire alarm system is especially intended to supply the wants of smaller cities of from, say, 2,000 to 15,000 population where the comparatively high price of installation, coupled with a relatively large expense of operation and maintenance, would make the introduction of almost any fire alarm telegraph prohibitive.

At the outset it may be stated that the inventor employs what is commonly known as the radial system, in which a series of radial lines are connected with a central office, one signal box only being included in each line. At the central office automatic receiving mechanism is provided to respond to the operation of the boxes and to also re-transmit the signal to the fire engine houses, tower strikers or to any other electromagnetically controlled indicating apparatus which may be employed.

Before entering upon a detailed description of the central office apparatus, it may be well to refer briefly to the signal boxes and their construction. These boxes are so arranged that instead of transmitting a predetermined group of impulses to indicate the box number, as is now commonly done by means of

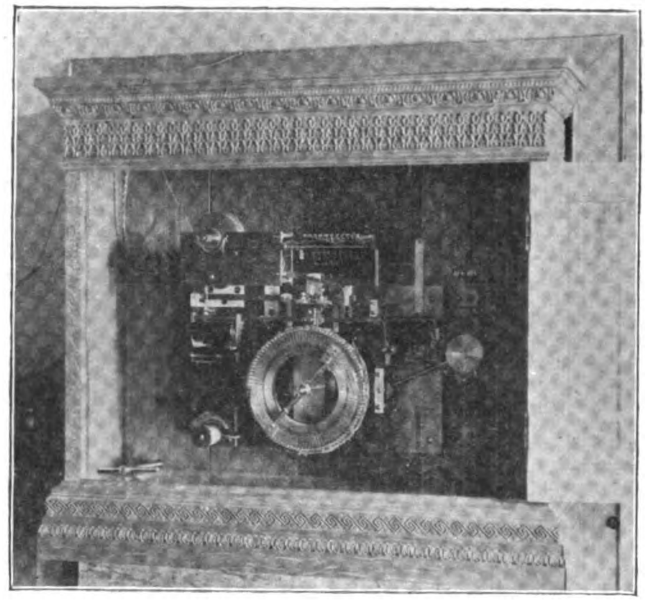


FIG. 1.—WALTER FIRE ALARM, CENTRAL OFFICE APPARATUS.

a breakwheel or similar device, a single impulse only is transmitted; that is to say, the normal condition of the circuit is merely changed and such change sets in operation the central office apparatus. In other words, the inventor has dispensed with all the complicated mechanism in the shape of clockworks, breakwheels, etc., in the signal boxes, and substituted therefor a simple circuit-closing device, without, however, sacrificing any of the valuable features of a closed circuit series system.

The central office apparatus, shown in Fig. 1 and diagrammatically in Fig. 2, consists essentially of the following:

1. A box selecting device for locating the box or boxes from which the alarm may be sent.

2. A re-transmitting device for transmitting the numbers of the boxes to the town bells, engine house gongs, registers or indicators.

3. Two open circuit batteries, one to furnish currrent for the

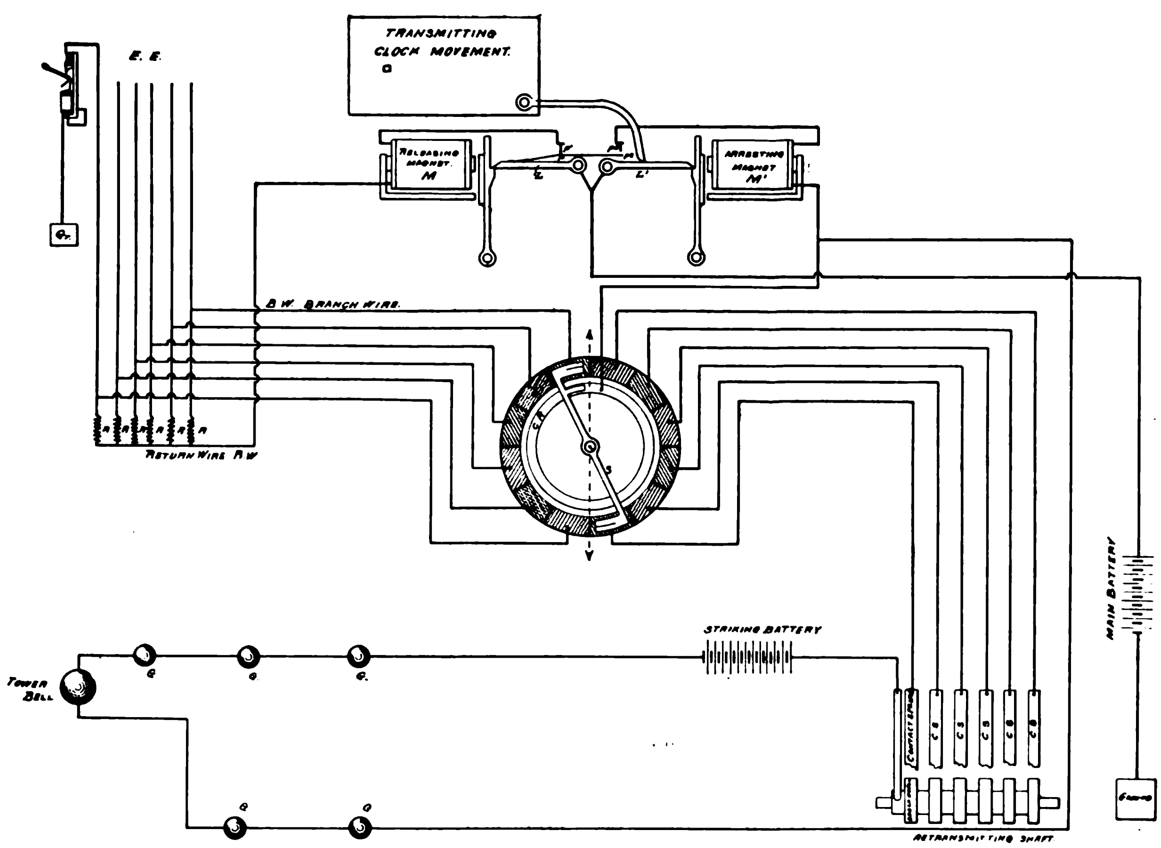


FIG. 2—WALTER FIRE ALARM SYSTEM.

box circuits and another for supplying the re-transmitting circuit.

In the box selecting device, Fig. 2, a series of terminals are mounted in the form of segments upon an insulated disc, and a rotating trailing arm or switch S successively engages the segments S^1 when put in motion by a releasing magnet M. The trailing arm or selector, as we shall hereafter call it, is rotated by a gravity driven device, which is automatically restored by the clock work that operates the re-transmitting device.

The question now suggests itself, "By what means is the selector made to stop at exactly the segment or terminal of the line from which the alarm is sent?" The solution of this question the inventor has accomplished in a very ingenious manner. Referring again to Fig. 2 and tracing any one of the box circuits from where it enters the central office at E, E, through the releasing magnet and main battery to the ground, it will be noticed that a resistance coil R is included in each line circuit. In closing the circuit at the box, by pulling down the handle bar, the releasing magnet M is energized, allowing the lever L to drop. This releases the motor escapement and sets the trailing arm S in motion. The falling of the lever L, however, has broken the circuit through the releasing magnet M at points P and P^1 and provided a new path for the circuit at P^2 and P^3, for energizing the arresting magnet M^1 whenever the selector shall have located the box.

It is evident, that in order to enable the releasing magnet to be operated by any one of the boxes, *all* of the lines must have a common path through the releasing magnet, but before the selector can pick out any one box circuit, the several circuits must first be separated or an equivalent condition established. This is accomplished by inserting the above mentioned resistance R at the terminal of each line, just before it reaches the releasing magnet. These resistances are all alike, and each has the same ohmic resistance as the releasing magnet.

At a point between this resistance and the box a branch wire BW from each line is led and permanently connected to a segment on the disc. Owing to the difference in resistance between the releasing magnet and the box magnet, of which we shall speak later, the circuit at the box still remains closed. The selector contacts successively with the several segments over which it passes, until it touches the segment leading to the line over which the alarm was given and at this instant a path of least resistance to the arresting magnet M^1 is completed through the brushes of the selector, causing magnet M^1 to release lever L^1, which, by falling, locks the escapement and leaves the selector resting on the segment. It will be seen, by tracing the circuits, that while the selector is moving, a path exists from each segment through its branch to any one of the box wires, down through its resistance R to the common return wire R W, up the calling wire and through its resistance; but the combined resistance of the two coils being too high for the battery to overcome, not until the proper segment is reached and all resistance coils are cut out, will the main battery be able to cause magnet M^1 to act.

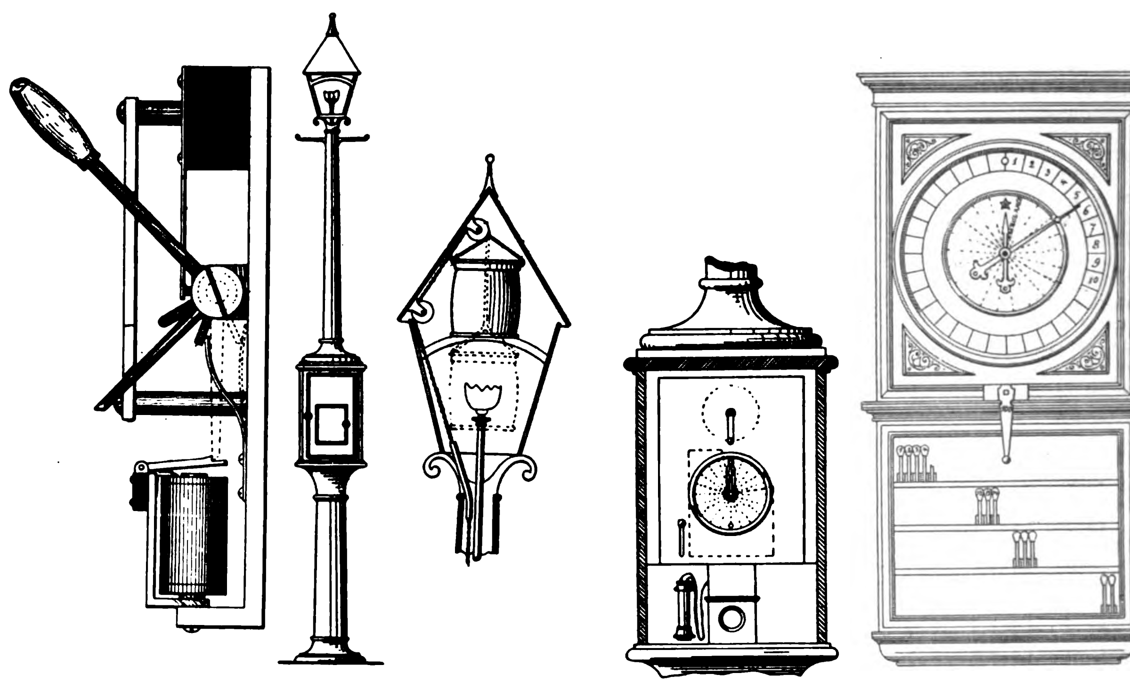
Referring to Fig. 3, the magnet in the signal box, being wound to the same resistance as the arresting magnet M^1, works in unison with it, in consequence of which the circuit is opened at the box, thereby restoring it to its normal condition.

The selector is now in position to admit of the transmission of the box number to the alarm bells or their equivalent, by means of the re-transmitting device. This consists of as many circuit wheels as there are boxes, mounted on a shaft which is driven by a clock movement. The arrangement is shown diagramatically in Fig. 1, the driving clock work being shown in outline only, for the sake of clearness. Over each break wheel is placed a flat contact spring O S (shown broken in the illustration) the two operating in the well known manner of the make-and-break wheel, so as to operate a striking battery in circuit with the alarm gongs or registers, whenever the circuit is closed by the selector through the proper line. The segments on the disc are divided in two parts indicated by the dotted line, the ones on the left being the terminals of the box circuits while the ones on the right lead to the circuit wheels. The selector having stopped on the proper segment, as previously explained, the opposite contact brush rests on the corresponding segment leading to the breakwheel. The circuit is now complete from one pole of the striking battery to tower bell and engine house gongs G to contact rings O R on the disc, thence through selector brush and segment to contact spring O S, breakwheel and shaft to the other side of striking battery. While the transmitting shaft is revolving, the circuit through all other breakwheels is of course open, because the selector brush can only rest on one segment at a time, thereby making the system absolutely non-interfering.

The clock work is started by the dropping of lever L^1, allowing the pivoted arm A of the clock movement to fall and thereby release the escapement. The transmitting clock work is arranged to revolve the breakwheel shaft four times, thus giving four rounds of an alarm, but can of course be easily arranged to give a greater or less number, if desired. The selector movement is automatically wound and the levers L and L^1 restored to their normal position after the alarm has been transmitted. This is accomplished by utilizing a portion of the power of the transmitting clock movement, which can be operated by a spring, gravity or other suitable power.

As previously stated, the signal box consists of a simple circuit closing device and a locking magnet, a detail view of which is given in Fig. 3. In "pulling" a signal box the handle bar is pulled down until the contact lever O assumes the position shown by the dotted lines and is held in that position by the retaining armature of the locking magnet. The circuit is thereby closed and remains so until the locking magnet has been actuated from the central office; but owing to a difference in resistance between the locking magnet in the box and the releasing magnet M at the central office, it is not until the arresting magnet M^1 is energized that the box magnet releases the handle bar and restores the circuit to its normal open condition. Provision is also made in the signal box whereby it is impossible to start the office apparatus until the contact bar is securely locked behind the magnet armature.

It will be readily seen that the alarm system as outlined above is not confined to fire alarm purposes, but can also be supplied to



FIGS. 3, 4, 5, 6 AND 7.—WALTER COMBINED FIRE ALARM AND POLICE SIGNAL SYSTEM.

police signal and similar purposes; in fact the inventor has already perfected a police signal system embodying the above principles.

In this system suitable receiving and transmitting mechanism is located at the central station and connected by wire with the several street boxes, which are preferably arranged in the shape of lamp posts, Fig. 4. The posts have suitable boxes containing mechanism for transmitting and receiving messages to and from the central station, and a telephone for verbal communication. A light signal is provided at the top of the lamp post for calling the attention of an officer to the box in case the central office desires to communicate with him. Fig. 5 shows in detail the arrangement of the calling signal. A colored globe is suspended over the light and by suitable mechanism is made to fall when released by the transmitting mechanism at the central station.

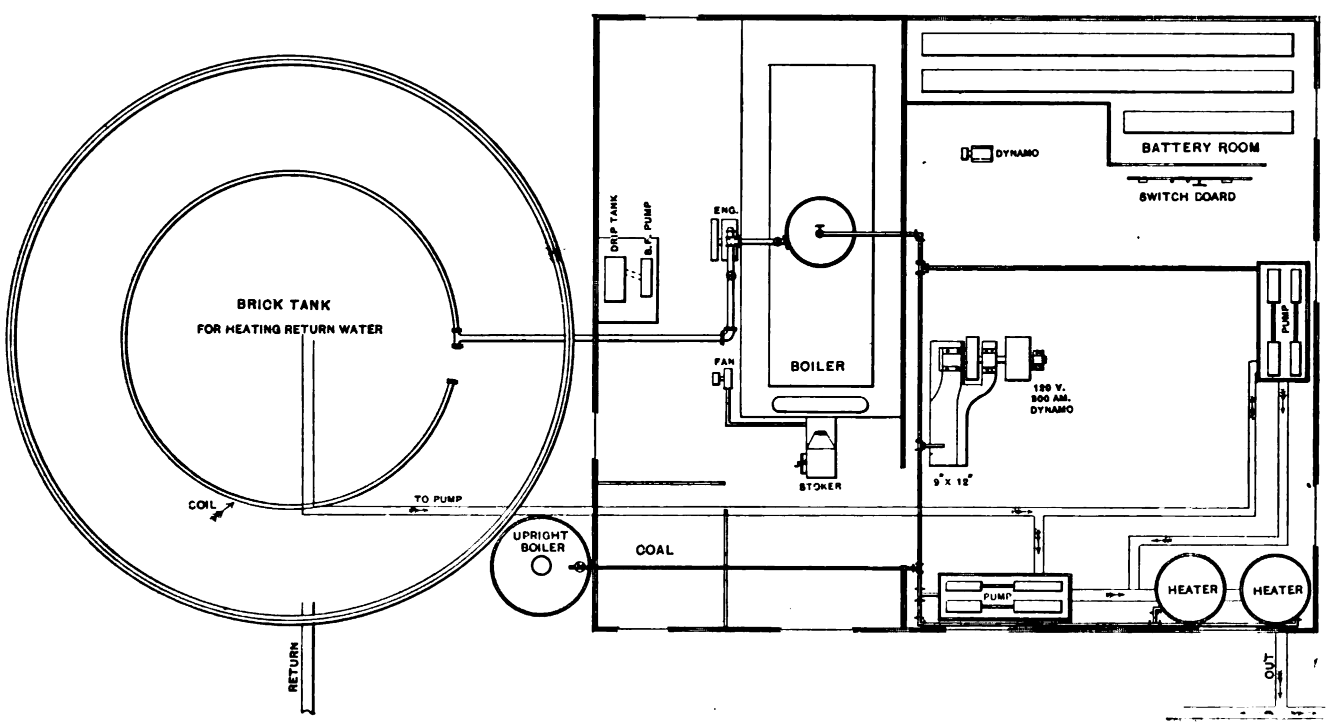
Fig. 6 shows the mechanism of the box in detail. A dial is divided into twenty or more sections, one for each message, and a revolving pointer can be set so as to cause the box mechanism to transmit the proper signal to the central office when the box is "pulled." Similar to the dial of the fire alarm central office mechanism, this dial has two sets of signal spaces, the ones on the right being used by the police officer when transmitting signals to the office, while those on the left half serve to indicate the receiving messages, the same pointer acting in each case. The central office apparatus is partially shown in Fig. 7 and similar to the fire alarm apparatus consists of a receiver and a box locator, a transmitter for sending messages and a spring jack switchboard for connecting the transmitter and telephone with the various box wires or terminals. The operation and use of these devices is well known and requires no further description. The entire office apparatus is practically automatic in its operation, each message and box number being printed on a register slip, together with the day of the month and hour of the day when received. The combination Police and Fire Alarm Co., of Chicago, has recently been organized to exploit Mr. Walter's inventions. We are indebted to Messrs. Davis, McAndrews & Co., sole agents, Monadnock Block, Chicago, for the details of this interesting system.

THE YARYAN SYSTEM OF HEAT DISTRIBUTION FROM ELECTRIC CENTRAL STATIONS.

To utilize the heat contained in the exhaust steam a number of central stations have installed steam distribution systems for heating dwellings, office buildings, etc., and with marked success. This plan, of course, requires the engines to be in operation at all times, or the admission into the distribution mains of live steam from the boilers, when the engines are shut down. For the purpose of utilizing all the heat in the exhaust steam, even when the amount called for by the distribution system does not equal that contained in the exhaust steam, Mr. H. T. Yaryan, of Toledo, Ohio, has inaugurated a system of hot water distribution which experience has shown to have many excellent features. The plan adopted by Mr. Yaryan is to store the heat of the exhaust steam by causing it to heat up the water in a large tank, well protected from radiation, for use when the engine is not running. When the engine is shut down the water from the storage tank is turned into the circulating pipes, drawing the hot water from the top of the tank through the pump, which forces it through the heater, where the temperature is increased by the exhaust from the pump, thence through the underground pipes and the coils in the various houses, and back through the return pipe into the bottom of the storage tank. It is found by experience that this plan is practically a complete success. The cooler water always assumes its normal condition at the bottom of the tank, the water of higher temperature always remaining at the top, in strata, so to speak, relative to temperature. The plant, which is shown in the accompanying engraving, consists of one tubular boiler, 84 inches in diameter and 16 feet long, one Jones under-feed mechanical stoker, one small engine and blower, one 36-inch upright boiler, two Hughes duplex pumps, 8 by 6 by 12 inches, controlled by a Fisher pump governor; two heaters, one Russell automatic 9 by 12-inch engine, one Knowles 5¼ by 3½ by 6-inch boiler feed pump and tank, one small dynamo and one Siemens & Halske dynamo of 36 K. W. and a storage battery of 55 cells. The supply pipes of the system are laid three feet below the surface of the street, and are boxed in and covered with some non-conducting material. The hot water is forced through the mains at the rate of 328 feet per minute with a pressure of 35 pounds at the pumps, which accounts for the small loss of 40 degrees in temperature, after the water has been circulated through the system. The water leaves the station at a temperature of 180 degrees F., and returns at a temperature of 140 degrees in zero weather. As there are 10,980 feet of street mains, this result is considered very flattering.

Twenty-seven houses are heated from this station, and of this number not more than ten are piped and fitted with radiators, the rest being fitted with hot-air furnaces, which have been utilized by fitting them inside with coils through which the hot water from the station circulates, the hot air being delivered through the hot air pipes, as formerly, by the old furnace system, at a temperature of 70 degrees in zero weather. The water is forced by pumps from a return drip tank where it is first heated to 150 degrees F., through two cast-iron heaters passing from them into the mains at a temperature of 180 degrees. The two heaters use exhaust steam, supplemented by live steam when necessary. The loss in the entire system, including boiler feed, is 900 cubic feet of water per twenty-four hours, taken from the city water works by meter. The electric light furnished is as near perfection as can be hoped for. The dynamos and batteries are worked in multiple from 5 P. M. until 10 P. M., the battery serving to even up any variation of load while the demand for light is heavy. All electrical connections to the dwellings are made underground in suitable conduits, the current being sold by meter at the rate of 10 cents per 1000 watts, at which figure the demand for light is greater than the present capacity of the station.

The amount of coal used is four tons per 24 hours run, and there is no smoke and no noise that is noticeable 150 feet away, a state of affairs which is very gratifying to those who live in the immediate neighborhood. This interesting plant which has been running since last summer, will be greatly enlarged in the Spring, and another will be erected in the business portion of Toledo.



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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIX. NEW YORK, MARCH 27, 1895. No. 360.

CONTENTS.

TELEPHONES ON THE "EUROPEAN PLAN."

AMERICAN hotels are run, as everybody knows, on two plans, the "American" and the "European." If you are housed under the inclusive American plan, you pay a lump sum per day or week, and that covers everything; if by the latter, you order simply what you want and pay merely for what you get. A good deal of the business of this country has been done on the American "flat rate" basis, which has many conveniences as well as many objections; and hitherto the telephone exchange service has been conducted in our cities on such lines. At the present time, there is a distinct breaking away from earlier happy-go-lucky methods and a desire on the part of both contractor and consumer to grade the payment by the exact amount of work done. The telephone subscriber is being told all the time how they do these things in millenial Europe, and he is decidedly favorable to scientific economy of expenditure.

This being so, it is a trifle startling to find Mr. Thomas Martindale, an estimable merchant in Philadelphia, inveighing against the new and modern plan. He appears to be laboring under a serious misapprehension. Of the method adopted in this city he says: "This new scheme of the Metropolitan Co. had not been long in operation before subscribers realized its true inwardness, and to-day there is loud protest against the scale." Now such a statement is distinctly untrue. We give below the scale referred to:

THE METROPOLITAN TELEPHONE AND TELEGRAPH COMPANY.

SCHEDULE OF MESSAGE RATES IN EFFECT NOVEMBER 1ST, '94.

(*Subject to Change Without Notice.*)

The rate for additional messages (i. e. messages used in excess of the number contracted for) will be proportionate to the amount of messages contracted for.

Number of City Messages.	Direct Line Rate.	Number of City Messages.	Direct Line Rate.
700	$120	1400	$181
800	130	1500	188
900	140	1600	195
1000	150	1700	202
1100	158	1800	208
1200	166	1900	214
1300	174	2000	220

TWO-PARTY LINE.—Rate $80.00 and upward.

For more than 2,000 messages per year, Direct Lines only will be used, and the rate of advance will be $5.00 per hundred, with $7.00 per hundred for extra messages.

This common sense schedule, somewhat higher in cost, went into effect in June, 1894. Up to date, we find upon inquiry, 2200 subscribers have taken service under the system. Of these 1200 are absolutely new subscribers who did not consider telephone service to be within their reach; while 1000 are old subscribers who have changed from various flat rates to message rate. The latter is entirely optional and the company has allowed flat rate subscribers to change over to message rate in all cases where they have wished it, without holding them to the letter of their existing contracts. Experience so far gained has justified a reduction, as above, of the messages rates at first fixed, and all subscribers have had the benefit of the reduction even

though they had come in under the first, higher scale. It is not unreasonable to suppose that further insight into the working of the system will result in additional reduction.

Instead of there being a protest against the message scale, we do not hesitate to say that it is growing rapidly in favor. It undoubtedly meets the needs of a large number of people who want, not too much telephony, but just enough. This is true whether the service is supplied under Bell patents or any other, and we hope to see such rates maintained till there is warrant for trimming down. The great trouble with the whole range of electrical work is that it has been done too cheaply, telephony included.

ARMATURE REACTION.

The large attendance at the meeting of the American Institute of Electrical Engineers last week, at which Messrs. Ryan and Thompson's paper on "A Method of Preventing Armature Reaction" was read indicates the interest which is still taken in the subject of dynamo design, and which indeed more than fifteen years of discussion seems to have increased rather than to have diminished. The subject of armature reaction, especially, has received more attention at the hands of dynamo builders, than perhaps any other one point in connection with dynamo design for it has long been recognized that upon it depends the smoothness of working of such machines. A perusal of the authors' paper can leave little doubt that they have accomplished what they set out to do and that they have achieved results of a highly interesting character. As was to be expected the discussion on the paper brought to the fore the perfection which had been attained in the design of the usual types of machine, and the expression of doubts as to the necessity of applying a device to overcome an evil which no longer existed in well designed modern machines. We must also confess to the belief that the authors have somewhat overestimated the commutator difficulties with modern machines now that the use of carbon brushes has become so common for all classes of work. Nevertheless we are by no means in accord with some of the critics who discussed the paper, and who could perceive no value whatever in the device of Messrs. Ryan and Thompson. Granted that a certain method accomplishes a desirable object, the only question at issue is, Can it compete commercially with existing machines, or, in other words, Is the cost prohibitory? The authors, it is true, admit that the cost of machines built according to their method is greater than that of the familiar type, but even the sharpest competition cannot prevent the adoption of apparatus which has merits beyond that of mere low cost. The same criticisms were launched against the machine designed by Mr. Sayers in England not long since, which is also specially constructed for non-sparking, yet we learn that these machines are gradually but steadily increasing in number, and recent improvements have made it possible to reverse them, so that the dynamo acts equally as sparkless when used as a motor. We doubt not therefore that Messrs. Ryan and Thompson's machines will find a market.

But even if it should prove that the principles embodied in their machines make the cost prohibitive the method itself is a valuable addition to our resources for overcoming an annoying difficulty and may find applications in directions not contemplated at present. On this account, if on no other, it is well that the authors of the paper have placed their work on record, and we hope that further experiment and experience may lead to the removal of the only objection which has yet been raised to their plan, namely its cost.

MODUS VIVENDI.

The rumors current for two or three weeks past of an impending consolidation of interests by the General Electric and the Westinghouse Companies, followed by the sharp advance in General Electric shares on the New York Stock Exchange and the moderate rise of Westinghouse shares at Boston, last week, indicated the existence of some basis of fact. On Friday last there emerged an announcement from a prominent firm of brokers that an agreement had substantially been reached between those companies for a pooling of patents and the discontinuance of patent litigation and stipulating that neither company should sue the other for infringement of patents henceforth. The announcement vaguely indicated that other "principal electric companies" were included in the agreement. In daily newspaper notices of the matter it is reported that the alleged agreement goes so far as to embrace mutual consents as to prices of material and machinery, "to prevent further ruinous competition in bidding for contracts."

We have been unable to get either an affirmation or a denial from officers of either company. They do not want to talk about the matter. It is tolerably clear, however, that some measure of the sort implied in the brokers' announcement has been under negotiation between the Westinghouse and General Electric people. Should it go no further than an abandonment of patent litigation, the saving of money to both companies would, apparently, go far towards producing better balance sheets in the yearly statements. In view of the meagre results so far secured, either in collecting damages or in establishing monopoly, through suits on patents relating to electric light and power, it would seem that a halt might well be called by the principal antagonists.

In respect to an agreement for the protection of prices—less positively affirmed in the various statements current—it may be said that similar attempts have seldom been long successful in any branch of production or commerce. It would be a noteworthy feat if any possible combination of electrical interests could maintain a tolerably uniform scale of prices, satisfactory to producers and sellers, for a year or two. There are competent and well equipped electrical manufacturers and engineers, a many, outside of the General Electric and Westinghouse, who are of course watching the situation with keen eyes, and who will be prompt to take advantage of any change in the present situation, both as to patents and prices.

The Institute Ticket.

We print on another page the Council nominations for the American Institute of Electrical Engineers this year. It is an admirable ticket. Dr. Duncan is an excellent choice and evidently has, as he deserves, a great many friends in the membership. Under his administration the Institute may look forward to a year of growth and prosperity.

THE MONOCYCLIC SYSTEM DISCUSSION.—III.

MR. SCOTT: There is one point to which attention was called by my able friend Mr. Steinmetz to which I take exception. That is his definition of a polyphase system or a polyphase motor. He was pleased to say that difference of phase in E. M. F. with no difference in current does not constitute a polyphase system, and he pointed out that if a coil and a lamp be placed in series the E. M. F. measured directly across the lamp and the E. M. F. measured directly across the coil would not be in phase with one another, but would occur at different times. So also if a coil and a lamp be placed in multiple so that the same E. M. F. is on the terminals of both, then the currents are not of the same phase. But he held that neither of these would constitute a polyphase system, because the flow of energy was not constant. A constant flow of energy may be taken as a definition of a polyphase system, so might difference of E. M. F. or difference of currents. As I understand a polyphase system, I do not mean that the E. M. F. at one part of the circuit may be one thing and at another part somewhere else another thing, either at a great distance or connected with a different piece of apparatus; that would not necessarily constitute a multiphase system; but if the two different elements with difference of phase cause the operation of that apparatus, then we have the essence of a polyphase system. If we have a motor and wind its circuits in such a way that the circuits shall differ in capacity or self-induction, if the currents in the different circuits differ in phase, and owing to this the apparatus operates and the motor runs, then we have something which should be legitimately considered as polyphase apparatus. We have an apparatus which operates due to the difference of phases, or to many phases, and in the polyphase motors that is the characteristic element. The element which causes rotation, the fundamental element, seems to be the shifting of the magnetic field in the apparatus. It is not fundamentally essential to the operation of such an apparatus that the currents give equal energy to the apparatus at all times, but that they may be supplied in such a way as to give the shifting field, which will cause the rotation and running of the apparatus. I would, therefore, call a multiphase machine one which has in it a shifting magnetic field of many phases, or currents producing these magnetic fields, rather than one having constant flow of energy to the apparatus.

The power wire operating in the monocyclic three-wire system is said to be a powerless wire. This wire is for the purpose of operating the motor while it is coming up to speed. The two great problems in an alternating current motor are: first, the bringing of the motor up to speed; and secondly, keeping it there. These are two different problems, and different methods are devised for effecting the two different results; and very often the elements which contribute to one detract from the effectiveness of the other. The power wire, if I am right in understanding this motor, does not necessarily supply power to the motor at the time when the motor is running at full speed, but it contributes to the power which is required for bringing the motor up to speed, and would continue to deliver power to the motor instead of lying idle and resulting in so much idle copper in our system if the motor were a complete and symmetrical motor instead of one which has possibly been made defective to meet the requirements of this system.

DR. BELL: The first question raised may be granted, that the monocyclic system is a modification of something. Is it now to be considered as a single-phase or two-phase system, or a polyphase system of some sort? I think that question was clearly answered by Mr. Steinmetz when he pointed out that you must consider as a polyphase system one in which the energy remains constant—the common characteristic of all polyphase systems, whether evenly balanced or unbalanced. In the monocyclic system we have three currents substantially in phase with each other and the total energy passes through zero. I fail to see how the widest possible extension of the definition of a polyphase machine could be made fairly to include it. The most that could be said would be that there might be a limiting case in which the unbalancing of a polyphase system might go on until the total energy would actually pass through zero. If that is so, it might serve equally well as a limiting case for either the single-phase or the polyphase system. It is certain that the monocyclic in its operation suggests a polyphase system. In the character of the currents which flow through it, and in the distribution of the energy, it is peculiarly single-phase in its character. I was interested in Mr. Scott's remarks on the subject of the four-wire connection of the two-phase; and in the second place, the three-wire connection of the two-phase system. Now, with a four-wire connection, it is, of course, possible to use the Edison three-wire system on each branch, if one so desires; but in order to do so, and to run motors at the same time, one must unlink the two three-wire systems; in other words, you must have two three-wire systems, each system being approximately balanced as to itself, and each three-wire system balanced as respects the other three-wire system occupying the same territory. They must be interlinked for motor service, and that is the reason which, I maintain, bars out the two-phase four-wire system from employing the Edison three-wire connection, just as it must bar out in the same way, and even more effectively, the three-phase system from operating on each of its three phases an Edison three wire system. It makes a complication of circuits for general distribution which would be perfectly intolerable, two three-wire circuits in the same territory, and each balanced with respect to the other—it would be something better imagined than described. In certain cases, for lights only, it may be applied, because you are at liberty to scatter your circuits, but even then it would require more or less balancing of the two systems, else you get into trouble w ith one side of the machine having a greater load than the other, which causes a difference in drop which cannot be compensated by compounding.

With the two-phase, three-wire system, Mr. Scott's point was well taken on the question of maximum voltage. However, if you are dealing with the maximum permissible on the transmission line, where the thing to be considered is not the maximum on the distributing system to translating devices, but the maximum permissible on the whole system, and if you confine yourself to that, you find that combining the two-phase into three wires requires excessive copper. If you confine yourself to the secondary system alone it will be possible to permit the same maximum voltage as on the straight Edison three-wire, and I should say that the same rule would apply to the reduction of copper in the three-phase three-wire system, or any other systems, in varying degree according to their character.

As regards the question of unbalancing I think I stated with a fair degree of distinctness that with any polyphase system, though unbalancing may occur, and occur in a serious degree, I do not believe it would be a common occurrence. I think I specifically included the polyphase systems in general.

With regard to the question of the reduced capacity of transformers operating on three phase or monocyclic systems: as a matter of fact there are three plans of working, we will say, with a three-phase system as regards its transformers; in the first place, we may have a composite transformer including all three legs of the circuits, which has been used with very fair results. Next we may use three transformers, or, finally, only two transformers. Sometimes it is more convenient to use three, and sometimes two. We must remember that there are not to be had an infinite number of sizes of transformers, nor an infinite number of sizes of motors. Therefore it is sometimes difficult to find transformers which will exactly fit a given horse power of motor, and the loss of capacity which is thus met in furnishing transformers too large for the motors (because we must be sure to have them large enough) may easily amount to 10 or 15 per cent., either with two or three phases, and unless special transformers are made to fit the motors, we are liable thus to require an increased total capacity of transformers, as well on two-phase as on three-phase systems. With the three-transformer connection for the three-phase circuit we have one very material advantage, which, perhaps, makes it worth while to employ it in many cases, and that is, if one of the transformers for any reason is crippled, we can operate at least two-thirds of the output with the remaining two; whereas, on the two-phase system, if one transformer gives out the motor is crippled, either by overloading and stopping absolutely, or able to run at half output as a single-phase motor, but in no case starting until the transformer is fixed. If two transformers are used, the statement has been made that the loss in output in connecting three-phase transformers is about 16 per cent. I would like to see experimental evidence brought up in this case. We have been informed in many well written technical articles that the output of the polyphase machine was thus and so in comparison with a single-phase machine. and we know that the facts do not fully bear out the theory. We are now given similar information in regard to the transformers. While I am not prepared to dispute the fact without having experimented on it, I would like to see some evidence that the difference in output rises to any practical magnitude.

As regards the teaser transformer, I think we may consider the secondary transformer on the monocyclic three-wire system as practically part of the power wire. It needs to be of small size and furnishes only a small amount of energy. With that connection that one transformer furnishes the power wire for the whole three-wire system. It is not a part of each motor, simply a part of a power wire, and as such it may be taken as a part of the installation belonging to the three-wire system. The single small transformer in the system furnishes the entire power wire for the whole system.

As regards the motor on the monocyclic two-wire system, it is correct, in a sense, to say that the motor does not know whether it is on a three-phase circuit or a monocyclic. As regards its operation, it does not know—that is, as regards the direction of the E. M. F's. in it.

It is a matter of perfect indifference which system it is on; but as regards the character of the currents and their direction, if the motor possessed an ammeter to put in its own coils, it would find there was a very large difference in the distribution of currents. As regards its magnetic qualities it would not matter, although the actual distribution of the current is widely changed. We have in the monocylic induction motor a motor which, in its

operative qualities, is like a polyphase motor. Nevertheless, the distribution of currents in it, although resulting in a perfectly symmetrical production of motive power, is something that you cannot find in any polyphase motor. It depends on the particular action used in the monocyclic system. It has essentially a single-phase current, although its effect as regards magnetism is closely similar to that of the true polyphase motor.

As regards the motor on the monocyclic three-wire system, I was much pleased with the ingenuity with which Mr. Scott constructed a large, able-bodied and well-dressed man of straw for the purpose of knocking the gentleman down and jumping on him with both feet. The motor is not a two-phase motor of any kind. It is an ordinary induction motor such as is used indifferently on three-phase or monocyclic systems. Doubtless, from the experience of the speaker, he realized how bad a bad two-phase motor could be. The winding of the monocyclic motor is in every respect similar to that of the three-phase motor. There is a possibility, and sometimes a great convenience, in being able to work a monocyclic generator as a synchronous motor. Used in such a way it works during its operation like any other synchronous motor. It is a possibility which is sometimes very convenient; the motor starts itself, and the teaser coil, when the motor is up to speed, produces no effect on the rest of the system if the motor is properly designed with reference to suppressing the E. M. F. of the teaser circuit. In the monocyclic three-wire system we have in the first place a three-phase motor structure, but operating on a monocyclic three-wire and teaser circuit, with the properties and distribution of currents, or electrical character, of the single-phase system. The actual details of operation in a monocyclic motor are somewhat complicated. Substantially we have a structure which in all its characteristics is only proper to be operated on the monocyclic or three-phase circuits. The currents which flow through it, however, are not three phase currents, the E. M. F's. being, however, 120 degrees apart. The currents are substantially in phase, but the magnetism produced is so distributed as to give a perfectly symmetrical torque on the motor, just as though it were run upon a polyphase circuit; a point which I think justifies me in the remark I made at the beginning, that the monocyclic system is to be regarded, not altogether as a modified and glorified single-phase, nor again as a decrepit and disreputable polyphase system, but rather as in a class by itself.

A METHOD FOR PREVENTING ARMATURE REACTION.[1]

BY HARRIS J. RYAN AND MILTON E. THOMPSON.

While making a thorough consideration of the subject of armature reaction some time since, one of the authors of this paper devised a means of entirely preventing armature reaction and resulting field distortion. This method consists in general in surrounding the armature with a stationary winding exactly similar in its magnetic effects to the armature winding, but directly opposed to it, and thus completely balancing all armature reaction. Fig. 1 is a diagram that shows the manner in which the coils are applied. Holes are provided immediately back of the pole surfaces, and through these holes are wound conductors which are placed in series with the armature. *The number of ampere-turns of the balancing coils crossing each pole face is equal to, and opposite in direction to the number of ampere turns on the corresponding part of the armature.*

The first machine designed according to this plan is illustrated

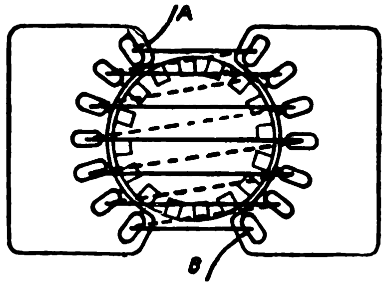
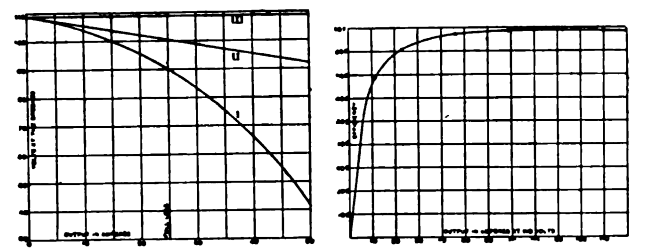


FIG. 1.

in Fig. 2 and Fig. 3 is a diagram of the results obtained by actual observation made on this machine when overloaded at normal excitation and speed, with and without the balancing coils. The pressure readings were taken at the brushes, and do not include the drop through the balancing coils when they were used. Characteristic I was obtained without the use of the balancing coils; characteristic II with the balancing coils; and characteristic III is the same as II with the balancing coils, when corrected for drop in pressure due to armature resistance. The same field excitation of 2600 ampere-turns was maintained at all times. It should be noted that without the balancing coils the pressure falls off uniformly and rapidly, from 109 volts at no load, to 41 volts at a load of 50 amperes, with violent sparking at all ranges of the overload.

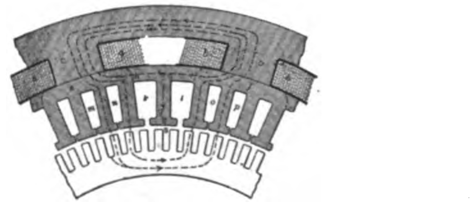
The authors also give a number of other curves exhibiting various characteristics, determined by means of the third brush method of field exploration. These show: 1. The production of a reversed field in the presence of the brushes at a full load current, and normal field excitation without the balancing coil. 2. The balancing coil slightly overcompensates the magnetic action of the armature, since the induction of the trailing pole tip is weakened, and that of the advanced tip strengthened, just the



FIGS. 3 AND 6.

reverse of what commonly occurs. In the case of a motor these conditions are reversed.

Fig. 4 shows an improved type of their machine with ring armature embodying the results of their experience on six previous machines. Fig. 5 illustrates the pole ring. Both commutator and armature core were hollow, and the winding thoroughly ventilated. All armature coils were wound simultaneously, and the winding was perfectly symmetrical. The pole ring which carries the six balancing coils was made in halves, and the pole-pieces were joined together by small connecting lugs as seen in the figure, in order to make the casting continuous. This construction permits the field coils to be wound in a lathe, and to be



FIG, 7.

easily removed from the fields at will. It is also a decided advantage to have the balancing coils and the pole-pieces through which they are wound, separable from the rest of the field. The following are the more important details of the design of this machine:—Capacity, 91 amperes at 100 volts or 10 kilowatts. Type of machine, six-pole, ring field of steel. Armature winding of cable through grooves in core. Armature ten inches in diameter outside, by five inches inside; number of grooves, 61—six conductors per groove. Grooves, $\frac{5}{16}$" wide by $1\frac{1}{4}$" deep; number of commutator bars, 122; total number of conductors, 366. Armature core and pole-pieces, five inches long. Mean distance between poles, $\frac{3}{4}$". Total magnetic flux, 1,800,000 webers; maximum density in armature teeth, 14,400 gausses. Maximum radial density in armature core, 8,500. Mean air-gap density, 5,000. Maximum field density, 14,000; length of air-gap, $\frac{1}{16}$"; M. M. F. for field, 642 gilberts; for air-gap, 1,600 gilberts; for armature, 99 gilberts; total M. M. F., 2,341 gilberts. Fields wound with No. 20 B. & S. G. wire. Armature, 366 conductors of No. 6 cable; five holes in each pole-piece for balancing coils. Balancing coils wound with copper ribbon. Compounding, two series turns on each field coil.

Weight of field casting, actual	218 lbs.
" " armature core, shaft and spider	98 "
" " " and commutator complete	185 "
" " " copper	48 "
" " copper for balancing coils, actual	55 "
" " field copper, actual	40 "
" " dynamo complete including base bearings, brush holders, brushes and 14 × 9 inch pulley	865 "

This machine was completed and tested in October, 1894, and the results of test were as follows: Speed of dynamo, 1,065 R. P. M.; voltage, 110. Current, 110 amperes. Time of run, one hour. Temperature of room, 71° F. Temperature of armature, 128° F. Temperature of field, 108° F. Rise of armature, 57° F. Rise of

1. Abstract of a paper read before the American Institute of Electrical Engineers, March 20, 1895.

field, 37° F. Field resistance, 110 ohms. Field current, 1.00 amperes. Field energy, 110 watts. Armature resistance, .0512 ohms. Armature winding loss, 618 watts. Balancing coil resistance, .0202 ohms. Balancing coil loss, 242 watts. Series resistance, .00955 ohms. Series loss, 115 watts. Core loss, friction, etc., obtained from energy absorbed as motor running light at full pressure, 450 watts. Total losses, 1,408 watts. Total output, 12,100 watts. Gross energy absorbed, 13,508 watts. Commercial efficiency, 88.7 per cent. For lighter loads the efficiencies are given by the curve in Fig. 6. This test was made after the machine had been running for several hours under various loads. On another occasion the machine ran one hour and twenty minutes under a load of 115 amperes at 105 volts with a rise of temperature of armature of 48° F.

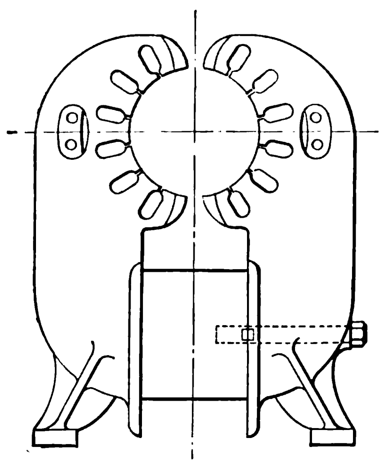


FIG. 2.

While the balancing coil entirely prevents field distortion and shifting of the neutral point, there is still something lacking for ideal commutation, even where armature action is prevented, so long as commutation takes place under a pole corner. During their experimental work on balancing armature reaction, the writers devoted considerable time to the problem of sparkless commutation, and as a result have devised an improvement to be used in connection with balancing coils, by means of which ideal commutation is attained. The device is simple, and accomplishes the desired end perfectly. It consists in bridging across the gap between the pole-pieces, attaching a commutation lug to the centre of this bridge and making the lug the centre of the balancing coil, the latter being provided with a few extra turns. The arrangement is shown in Fig. 7, which represents a portion of the field circuit sectioned centrally in the plane of rotation. Referring to the figure, *aa* and *bb* are two field coils wound round the pole necks C and D; G is the commutation lug which is attached to the middle of the lugs H I, which latter bridge across the gap between the pole-pieces E and F. The balancing coil (not shown) is wound through the holes K, L, M, N, O, P, with the commutation lug G at the centre of the coil. The path for magnetism is indicated by the dotted lines. It will be noticed that a part of the magnetic lines are shunted across between the pole-pieces E and F, through the bridge lugs H I, and do not pass through the armature. Now when there is no current in the armature or balancing coils, it may be easily seen that the fall of magnetic potential from E to F is the same by either the path through the bridge lugs, or through the armature, and that the commutation lug G attached to the middle of the bridge lugs, must be at the same magnetic potential as the armature teeth opposite, for the latter are connected to the middle of the armature circuit. Therefore, under these conditions, which are practically what we have when the machine is running light, there will be no field between the surfaces R and S of the commutation lug and armature respectively. If then our brushes are set so that commutation takes place while the short-circuited coil is passing under the commutation lug we have the correct conditions for sparkless commutation. When the machine is loaded, the excess of ampere-turns of the balancing coils over ampere-turns of the armature, brings a magnetizing force to bear on the lug G in the direction indicated by the arrow. This tends to increase the magnetism through H and diminish it through I, but as H is normally saturated, there will be very little increase in its magnetism. There will, however, be a field established under the commutation lug, by the deflection of the lines from the bridge lug I through the commutation lug and armature, and it is evident that the stronger the current in the balancing coils, the stronger will be the field under the commutation lug. We, therefore, again have the correct condition for sparkless commutation when the machine is loaded, provided our balancing coils are so proportioned as to give us a commutation field of proper strength. From this it will be seen that at all times the commutation field is proportional to the current, and that for all loads we have the requisite conditions for sparkless commutation without shifting the brushes.

So much for the theory of this plan, and now comes the important question, "Will it work in practice?" We are able to answer without hesitation that such a machine performs as well in practice as in theory, and that actual tests show absolutely sparkless commutation from no load to 50 per cent. overload with fixed metallic brushes. More than this, practice confirms another theoretical advantage of this improvement which we have not yet touched upon. It will be noticed that the commutation field is obtained by the deflection of lines from bridge lug I and that the lines so deflected pass through the armature, and consequently are added to the useful magnetic field. We might expect from this, and from the fact that since the brushes are midway between the poles, there are no back ampere-turns, that the machines would not compound somewhat without a regular compound winding. This theory was entirely sustained by actual trial. It was found under test, that by slightly shifting the position of the brushes forward or backward, it was possible to make a few of the armature-turns act with or against, the field winding at will, and this without any effect on the sparkless commutation, so long as the brushes were not moved beyond the limits of the

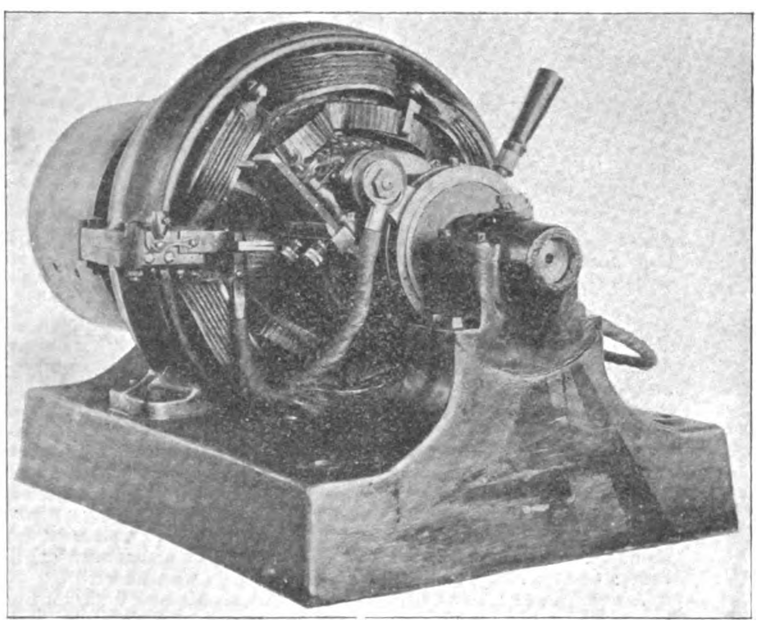


FIG. 4.

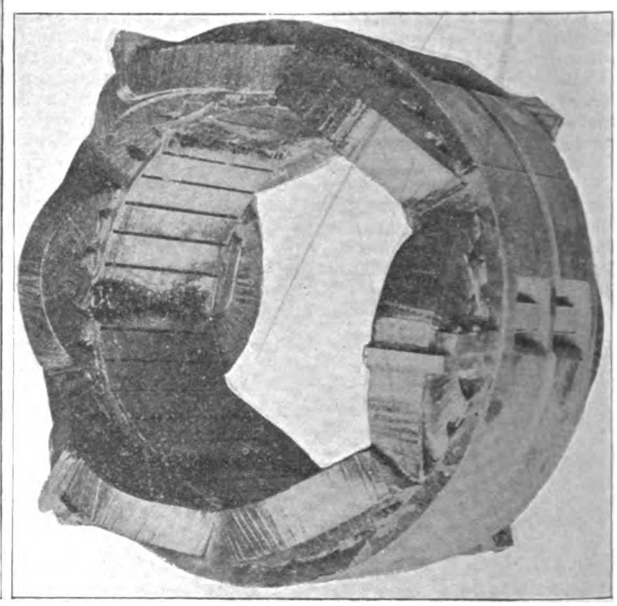


FIG. 5.

commutation field. The result of this is that by simply shifting the brushes, the compounding of the machine may be so changed that it can be adjusted at any point from 10 per cent. drop to 10 per cent. over-compound, and this without interfering with the commutation in any way.

Thus by this simple contrivance we attain sparkless commutation without shifting of brushes, and a compounding adjustable at will.

Direct experiment has shown that this system of commutation will not give satisfactory results except when used in connection with balancing coils. Aside from the effect on commutation, however, balancing coils have some very important advantages to which we will briefly call attention. By their use the capacity of a machine of given size and weight may be greatly increased, and the resulting machine still be far better in quality and operate more satisfactorily than those of ordinary design.

With the standard peripheral velocity of 3,000 feet, it is easy to get an output of 20 to 30 watts per pound total weight of dynamo, and for large sizes of machines even still greater output per pound. With armature reaction balanced, there is no necessity for high reluctance in air-gap and teeth, and it is therefore made as low as possible for the whole magnetic circuit. The air-gap is reduced to what suffices for clearance, and the armature and field are worked at as low densities as is consistent with economy of iron. By this means from one-half to three-fourths or even more, of the ampere-turns on the field may be saved with a corresponding saving in field copper and field energy. This, and the reduced core losses reduce the fixed losses in the dynamo to a minimum, bringing them below what is possible with the ordinary construction, and the result is a very material change in the shape of the efficiency curve of the machine.

The extra cost of applying these improvements to a dynamo is far more than balanced by the saving effected in materials, and the writers believe that the application of these methods of design in dynamos would make a pronounced and important step towards the practical perfection of this class of machinery.

LETTERS TO THE EDITOR.

ELECTRIC LIGHTING FOR CARRIAGES.

I note the article upon this subject which appeared in your issue of February 6, and take this opportunity to correct some of the information recorded in the report sent to the U. S. State Department by the United States Consul of Havre. Mr. C. W. Chancellor has evidently not gone into the historical work relating to the lighting of carriages by electricity. For instance, he states that the Prince of Wales was the first to adopt this system in London. This is not so, for I may say the writer had the honor of lighting the Lord Mayor's carriage for Mr. Alderman Knight, the then Lord Mayor of London, as far back as 1883 by the same methods, which I claim to be the first carriage ever lighted in England by electricity—particulars of which were recorded in the London *Times, Standard, City Press* and many of the scientific journals published at the time of the event.

I may say my methods were about the same as those now adopted, for the lighting of the Lord Mayor's carriage was carried out by placing under the coachman's seat a small 8-cell, 20 ampere-hour Woodward storage battery which was used to light three 16 volt Shippey low resistance glow lamps, two in the lanterns as side lights and one in the frosted globe enclosed in a silver-plated fluted "Star reflector," in order to distribute the light evenly throughout the carriage.

The great drawback to the advancement of carriage electric lighting in England for many years was caused by the attitude of the E. P. S. Company, holders of the Faure battery patents, who unfortunately would not do this class of business themselves or allow others to do it; another drawback was caused by the difficulty which existed for many years in England in getting carriage accumulators recharged at a moderate price. Faure's patent having expired and many charging stations having sprung up in several provincial districts, these past difficulties need no longer prevent this method of lighting becoming more general in such districts, or even in others by using a reliable, primary battery to supply the current. The Prince of Wales, the Rothschilds, the German Emperor and many other notables and country squires have recently availed themselves of the method of lighting, the advantages of which, when better known by the Upper Ten, cannot fail to make both carriage and omnibus lighting an important section of the electrical industry. The modern system of electric carriage-lighting, as carried out by the Bristol Battery Company and exhibited at the Antwerp Exhibition last year, showing a new carriage-lamp made by me for this firm, containing "Fiberite" filaments and specially constructed for producing a more brilliant light from the energy consumed, has undoubtedly had the desired effect of waking up Parisian carriage builders and continental electricians to the many advantages and brilliant effects to be obtained from this method of carriage lighting; and from the increased demand for small carriage lamps, both for England and abroad, it is clear this method of lighting is being more fully developed throughout Europe.

ARTHUR SHIPPEY.

LONDON, ENG., March 6, 1895.

THE ROWLAND IMMERSED ELECTROMETER

IN the Jan. 29 issue of THE ELECTRICAL ENGINEER, I notice a description of "The Rowland Immersed Electrometer." It is obviously not known that in the English patent No. 11,862 of 1890 Prof. Ayrton and Mr. Mather claimed "the improved method of increasing the sensibility, or preventing sparking, in electrostatic measuring instruments by filling, or partially filling, the interior with a medium of high specific inductive capacity, or of great dielectric strength."

A large number of experiments were carried out in Prof. Ayrton's laboratory to find out the liquid best combining high specific inductive capacity with high specific resistance and the liquid was found to be alpha bromo naphthalene.

An electrostatic voltmeter of the Ayrton and Mather type in which the needle and inductors were entirely immersed in alpha bromo naphthalene was shown last year at a meeting of the Physical Society.

B. K.

LONDON, ENG., Mar. 2, 1895.

EXPLANATION OF A CURIOUS LIGHT EFFECT.

In regard to the letter of Mr. M. Logan printed on page 227 of the ENGINEER of March 6, concerning a curious light effect observed in an asbestos-lined switch-box on throwing the switch, may I suggest that the effect may be the result of an optical illusion? It is a fact of common observation that any bright light suddenly flashing and disappearing will leave its impression for a few seconds on the retina, and from what I have myself often noticed I can easily conceive of such an effect as seen by Mr. Logan. This of course could be easily verified by covering the eyes closely till after opening the switch.

It is also not impossible that the light is due to phosphorescent matter in the composition of the box, particularly if it has been painted with india-rubber paint, in which phosphorus may exist as an impurity.

GEORGE W. COLLES, Jr.

HOBOKEN, N. J., Mar. 11, 1895.

WHY A MERITORIOUS EXHIBITOR WAS EXPELLED.

THE reason why Mr. Woolf was requested not to continue his exhibit during the evening at the recent exhibition of the New York Academy of Sciences was this: Mr. Woolf had on his table a microscope in which he said that he showed living disease germs, which he at once destroyed by a spray of the liquid prepared by him. The biologists present reported to me that Mr. Woolf was *not* showing any living disease germs, and that it would be impossible for him to show any such germs with the objective he was using.

Your sense of "justice" seems to force you to write editorials first and ask for facts afterwards.

J. K. REES,
PRES. N. Y. ACADEMY OF SCIENCES.

New York, Mar. 22, 1895.

(Unfortunately for Pres. Rees' theory, we investigated first and then wrote our editorial. The above "explanation" most decidedly fails to explain the disgraceful occurrence on which we commented last week. The reader might infer from the above letter that Mr. Woolf did not show any living organisms whatever. We therefore repeat that we personally observed the movements of living organisms under the microscope, which movements ceased the instant the slide was sprayed with electrozone. Mr. Woolf did not make the statement that he was showing *disease* germs, but he did state that the germs which he exhibited were more resistant to destruction than the ordinary disease germs, thereby demonstrating the power of his disinfectant. The existing reports of recognized bacteriologists rendered it unnecessary to make comparative tests with disease germs, and we are glad to know that Mr. Woolf showed such excellent good judgment and common sense in refraining from exhibiting in a crowded assembly forms of germs, contact with which might have jeopardized the life of those whom he sought to instruct. But aside from the question whether the germs killed by Mr. Woolf were pathogenic or not, that gentleman was not asked to perform any specific act in the special invitation extended to him by the management. He was invited to show the method of preparation and the potency of his disinfecting material with the aid of the microscope and these conditions he fulfilled to the letter. We still insist that Mr. Woolf's treatment at the hands of the "committee" was in the highest degree discourteous and that an apology is due him. EDS. E. E.)

COST OF CENTRAL STATION STORAGE BATTERIES.

I notice in the last issue of your journal a letter from Mr. Nelson W. Perry, making some corrections in his paper read in Cleveland. I am amazed at his leaving uncorrected in this letter his figures on the results of electric storage, when it was clearly shown at the convention that his figures were not only ridiculous but false.

For instance, Mr. Edgar (of the Boston Edison company, owners of the largest electric storage battery plant in the world) was kind enough to publish the exact cost of this battery, and Mr. Perry's figures are 50 per cent higher than the price Mr. Edgar's company actually paid.

Mr. Perry has evidently not understood Mr. Edgar's figures, and has also failed to distinguish between a horse-power and a horse-power hour. Figuring batteries at a 12-hour rate of discharge, the cost per horse-power hour is of course much lower than when worked at an hour and a half rate, and even when worked at an hour and a half rate Mr. Edgar's figures were $33.33 per horse-power hour, which would amount to about $24 per horse-power when worked at a 12-hour rate.

It is a fact which cannot be disputed, that batteries can be installed to-day, of central station type, for this latter figure, and why Mr. Perry should insist upon stating and re-stating figures of which he has absolutely no knowledge, I am at a loss to understand. By substituting correct figures as to first cost of storage batteries, and the cost of maintaining the same, the results obtained are as follows:

	Recapitulation.		Savings effected.	
	Coal, $1.75.	Coal, $3 50.	Coal, $1.75	Coal, $3.50.
Present method. Steady load	$48.68	$65.62	$.....	$.....
" Gas Engine	88.28	103.61	29.50	44.79
Combined Feed and Steam Storage	94.42	111.85	23.36	37.05
Feed Storage	97.58	117.58	20.20	30.82
Without storage. Load factor 25%	117.78	148.40	.....	.....
Steam Storage	97.24	114.27	20.54	34.13
Complete Battery Storage	83.19	100.12	34.59	48.29

HERBERT LLOYD.

PHILADELPHIA, PA., Mar. 22, 1895.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the regular monthly meeting of Council, held March 20th, the following Associate Members were elected: Thomas D. Boyles, Electrical Engineer, General Electric Co.; residence, 58 Washington Ave., Schenectady, N. Y. W. J. Davis, Jr., Electrical Engineer, General Electric Co., Schenectady, N. Y. John D. E. Duncan, 81 Maplewood Ave., Pittsfield, Mass. William Esty, Instructor in Electrical Engineering, State University, Urbana, Ill. Joseph W. Frost, Secretary National Automatic Fire Alarm, 835 Broadway, New York City. W. L. Garrels, Student, Westinghouse Electric and Mfg Co.; residence, 4531 West Pine Boulevard, St. Louis, Mo. Lucien H. Gilmore, Assistant in Physics, Stanford University, Palo Alto, Cal. James E. Grist, Mechanical Engineer, Phila. Traction Co.; residence, 918 North 44th St., Philadelphia, Pa. Wm. J. Hiss, Jr., Senior in Electrical Dept., Lehigh University; residence, 28 Market St., Bethlehem, Pa. Henry C. Jones, Member of firm, the Electric Construction and Supply Co., Montgomery, Ala. Rollen N. Larrabee, with the Western Electric Co.; residence, 30 West 25th St., New York City. P. R. Middlemiss, Post Graduate Student, Mech. and Elec. Engineering, Tulane University, New Orleans, La.; residence, 1616 Felicity St.; Mariano L. Mora, C. E., E. E., 63 West 70th St., New York City. Chas. T. Mosman, Electrical Engineer, General Electric Co.; residence, 58 Washington Ave., Schenectady, N. Y. Ralph D. Mershon, Electrical Engineer, Westinghouse Elec. and Mfg. Co., Pittsburg, Pa. M. J. O'Sullivan, Superintendent, Electric Light, B. & O. R. R. Co.; residence, 227 Mount St., Baltimore, Md. Price I. Patton, Sheble & Patton, Ltd., 1022 Arch St.; residence, 3926 Walnut St., Philadelphia, Pa. Thomas A. W. Shock, Electrical Engineer, Electric Light and Power Co., Sacramento, Cal. Charles H. Stanton, with C. H. & H. Stanton, Electrical Contractors, 1517 Walnut St.; residence, 134 South 3d St., Philadelphia, Pa. Alex. Stratton, with Crocker-Wheeler Electric Co., N. Y.; residence, 2013 5th Ave., New York City.

The following associate members were transferred to membership: William Henry Powell, Electrician, Mather Electric Co., Manchester, Conn. Alonzo S. Kimball, Professor of Physics and Electrical Engineering, Worcester Polytechnic Institute, Worcester, Mass. Edgar Woods Mix, Electrician, Thomson-Houston International Electric Co., Paris, France.

As required by the rules of the Institute, the Council canvassed the nominating papers received from the membership and prepared the following ticket:

President, Dr. Louis Duncan, of Baltimore.

Vice Presidents.—Dr. M. I. Pupin, New York City, W. F. C. Hasson, San Francisco, Cal., Angus S. Hibbard, Chicago.

Managers.—Carl Hering, Philadelphia, Bion J. Arnold, Chicago, Charles F. Scott, Pittsburg, Dr. Cary T. Hutchinson, New York City.

Treasurer.—George M. Phelps, New York City.

Three Vice-Presidents hold over by the rules, as follows: Prof. W. A. Anthony, Prof. Francis B Crocker and James Hamblet, and the following Managers: Prof. Harris J. Ryan, Charles Hewitt, J. J. Carty, W. J. Hammer, A. E. Kennelly, W. D. Weaver, Charles S. Bradley and W. B. Vansize.

At the meeting of the Institute at 12 West 31st Street, in the evening eighty members and guests were present. A paper on, " A Method for Preventing Armature Reaction," by Prof. H. J. Ryan and Milton E. Thompson, was read by the former. The discussion was participated in by Townsend Wolcott, W. L. Bliss, E. A. Merrill, Dr. C. T. Hutchinson, C. S. Bradley, C. O Mailloux, Dr. C. E. Emery, A. E. Kennelly, G. S. Dunn and Maxwell M. Mayer.

The regular monthly meeting of the Western Members was held at Armour Institute, Chicago, on the 20th of March, Mr. S. A. Rhodes in the chair. The paper was read by Prof. Fortenbaugh, of the University of Wisconsin, and received marked attention from an audience of nearly fifty. After the reading of the paper, Mr. B. J. Arnold opened the discussion which proved very interesting and which was participated in by Messrs. Abbott, Summers, Kammeyer, Prof. Stine, Gutmann, Leiford, Prof. Fortenbaugh and others. There being no further business, the meeting adjourned, after a vote of thanks having been given to Prof. Fortenbaugh.

LEGAL NOTES.

WESTERN ELECTRIC CO. VS. MIANUS ELEC. CO., ET AL.—INJUNCTION FOR INFRINGEMENT OF SWITCH HOOK.

On Saturday, the 16th inst., Judge Shipman, of the United States Circuit Court, sitting at Hartford, Conn., granted a Final Decree against Franklin T. Palmer and Ray Palmer, of Mianus, Conn., and against the Mianus Electric Company, Charles F. Gillette and Isaac Husted, in a suit brought against them by the Western Electric Company of Chicago, for infringement of the Roosevelt Switch-Hook Patent No. 215,837, adjudging that there had been infringment, ordering the defendants to pay damages and costs, and decreeing that a perpetual injunction issue against the defendants, restraining them from further infringing the letters patent upon which the suit was based.

BAXTER ELECTRIC MOTOR CO.

Under an order signed by Judge Dennis in Baltimore March 18, Circuit Court No. 2 assumed jurisdiction of the trust created by the mortgage given by the Baxter Electric Motor Company to the Safe Deposit and Trust Company on June 12, 1890, to secure the payment of $100,000 5 per cent. ten-year bonds. The petition was filed by the trust company through Gans & Haman, attorneys. It states that one of the conditions of the mortgage was that the trustee could take possession of and sell the trust property when the half-yearly interest was in default for three months, and such action was requested by the holders of one-fourth of the bonds. This condition has been met, it is stated, and the property has been held for the trustee since the 2d of last November.

OBITUARY.—DR. P. H. VANDER WEYDE.

Dr. Peter H. Vander Weyde died last week at his residence in New York City. He had been ill for several days. Prof. Vander Weyde was born in Nymegen, Holland, in 1813. He studied at Durpldorf, and graduated from the Royal Academy at Delft. He was a scientific writer and teacher in Holland, and professor of mathematics and natural philosophy at the Government School of Design. In 1849 he came to New York; he studied and graduated from the New York University Medical College in 1856, and practiced medicine until 1859. In that year he was appointed professor of physics, chemistry, and higher mathematics at the Cooper Institute. He was also professor of chemistry in the New York Medical College. In 1864 the chair of industrial science was created for him at Girard College, Philadelphia. He resigned this professorship a few years later, and returned to New York. He was for a great many years active in electrical work, as an inventor, writer and lecturer. He was also at one time president of the New York Electrical Society. His body was cremated.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 19, 1895.

Accumulators:—

Accumulator Plate, G. R. Blot, Paris, France, 535 885. Filed May 22, 1894.
The plate is built up of ribbon with mechanically formed asperities having the maximum expansion of which they are susceptible and arranged to permit of easy circulation of the electrolyte.

Conductors, Conduits and Insulators:—

Tip for Flexible Electric Conductors, C. H. McEvoy, Lowell, Mass., 536,153. Filed Feb. 4, 1895.
Pipe and Mode of Lining Same, W. T. Ruete, New York, 536,998 Filed Dec. 18, 1894.
Consists of a metal pipe lined with one or more strips of paper or other fibrous material introduced lengthwise into the pipe and then cured by immersion in a bath of insulating material.

Dynamos and Motors:—

Alternating Current Motor, H. Hutin, & M. Leblanc, Paris, France, 536,032. Filed Nov. 17, 1892.
Claim 1: The method of rotating the polar line or lines of magnetic field of force, produced by energised circularly arranged field magnet coils, which consists in dephasing, with reference to each other, the alternating currents of the same period, passing through distinct branches of said coils, by producing a difference between the self-inductions of said circuits by differences of static capacity.

Electro-Metallurgy:—

Method of Plating Aluminum, W. H. Legate, Hartford, Conn., 536,152. Filed July 18, 1894.
The metal is first pickled then washed in a potash solution and then treated in a solution containing flaky carbon or soot; it is then plated with a layer of zinc, another of copper and then with the metal desired.

Lamps and Appurtenances:—

Incandescent Electric Lamp, W. S. Lowe, Lima, Ohio, 535,838. Filed Oct. 15, 1892.
The stem on which the filament is mounted is formed into a conically shaped reflector to diffuse the light.
Electric Arc Lamp, G. R. MacIntire, New York, 535,840. Filed July 5, 1894.
Details of construction.
Electric Arc Lamp, G. R. MacIntire, New York, 535,841. Filed July 5, 1894.
A double carbon stand or bracket lamp with special details of construction.
Electric Arc Lamp, G. R. MacIntire, New York, 535,842. Filed July 10, 1894.
Details of construction relating to a lamp employing curved carbons.

Miscellaneous:—

Electric Sign-Changing Device, W. Sears, Boston, Mass., 535,865. Filed Feb. 19. 1894.
Electric Program-Clock, F. Frick, Waynesborough, Pa., 535,948. Filed May 28, 1894.
Protective Device for Electrical Appliances, J. J. O'Connell, Chicago, Ill., 536 095. Filed Nov. 28, 1894.
Places between the plates of a carbon lightning arrester a textile fabric in connection with a mica strip.
Method of and Apparatus for Obtunding Nerves, W. P. Horton, Jr., and A. B. Jones, Cleveland, Ohio, 536,905. Filed Mch. 31, 1893.
Consists in (first) applying to that side of the patient's face on which the tooth is located, an electrode which is connected with one pole of an electrical generator, (second) connecting the excavating instrument with the other pole of generator; and (third) varying the current outside the body of the patent.
Induction Coil, A. F. W. Meyer, Blue Island, Ill., 535,917. Filed Nov. 27, 1894.
An induction-coil having a spool, primary and secondary wires coiled side by side about the spool and separated by interposed insulation, the number of secondary coils exceeding by one the number of primary coils, and soft iron expanded heads on the opposite ends of the spool.

Railways and Appliances:—

Insulated Trolley Section and Crossover, M. M. Wood, Chicago, Ill., and C. K. King, Mansfield, Ohio, 535,971 Filed July 18, 1894.
Details of construction.
Apparatus for Automatically Limiting Speed of Electric Cars, L. S. Wright, Philadelphia, Pa., 536,055. Filed Dec. 8, 1894.
A governor for controlling the electrical and braking system.
Collapsible Conduit for Electric Railway Conductors, H. C. Grant, New York, 536,076. Filed Sept. 17, 1894
The conductor is placed in enclosing plates, which collapse as the car passes along and allows contact to be made to a current conducting device passing through the upper plate to the car.
Conduit Electric Railway, F. P. Bergh and C. W. Tarbox, New York, 536,-936. Filed May 25, 1894
A series of exposed points are connected with a continuous insulated conductor by the car as it travels along and contact is maintained with at least one of these points all the time by means of a longitudinal shoe or skid carried by the car.
Closed Conduit Electric Railway, J. F. McLaughlin, Philadelphia, Pa., 535,993 Filed Oct. 28, 1894.
A conduit composed of sections having switch boxes connected thereto by laterally extending necks, in combination with supports having extensions forming the bottoms of the switch boxes.

Telegraphs:—

Spring Winding Means for Printing Telegraph Instruments, J. Burry, Long Island City, N. Y., 535,310. Filed May 12, 1894.

Telephones:—

Automatic Toll-Box for Telephones, H. C. Root, Brooklyn, N. Y., 536,100. Filed Nov. 30, 1894.
Claim 1:—An automatic toll-box having a chute for the passage of different sized coins, a gate in the pathway of said coin normally open to allow improper coins to pass it, in combination with means whereby the said gate is closed by the introduction of a proper toll coin, a signalling circuit controlled by the said toll coin, and means for gradually opening the said gate to allow a detained toll coin to pass.
Electromagnetic Signal, T. Spencer, Cambridge, Mass., 536,104. Filed Sept. 10, 1894.
Relates to a self-restoring drop.

S. K. C. 2 PHASE APPARATUS IN BROOKLYN, N. Y.

A search light on the roof of the station of the Citizens' Electric Illuminating Co., at 14 Rockwell place, Brooklyn, acted as a guide to the guests who had been invited to the station on Friday, March 22. The occasion was the exhibition of two-phase apparatus, and many well-known electrical people were present. The generator was a 60 K. W. Stanley two-phase machine, operating a bank of incandescent lamps and a number of Kester and Bergmann arc lamps on one circuit, and on the other running a 10 H.P. Stanley alternating current motor. The white marble switchboard installed for this apparatus carried the alternating current amperemeters and voltmeters of Stanley manufacture, and the transformers were of the same make. The interest in the practical side of two-phase work was manifested by the ever-changing group surrounding Mr. E. E. Stark, the electrician in charge, who was kept busy during the evening explaining the S. K. C. system which embodies the machinery and instruments already mentioned.

The genial President of the Company, Mr. Bernard Gallagher, and General Superintendent E. F. Peck, gave the guests a warm welcome.

On the third floor of the building, one of the office rooms was converted into a parlor for the reception of the many ladies present, and in another of the offices a collation was spread. The running of the S. K. C. system bore a significance beyond the mere exhibition of two-phase work. It is more than likely that the Citizens Illuminating Co. may find it desirable to install apparatus of this kind as a permanent thing, marking the march of progress in things electrical and giving to the central station an ability for increased service to its subscribers with considerable economy of room.

PARTRICK & CARTER SAMPLE BOARD.

Partrick & Carter Co., of Philadelphia, have prepared a very handsome sample board of some of their house goods specialties, designed especially for small dealers and those who do not as yet carry a stock of such supplies. Everything is connected and in complete working order for practical exhibition. The board is made of hard wood with dealer's name and address in gilt letters. An advertisement in this issue of THE ELECTRICAL ENGINEER shows an illustration of this new sample board, which will be boxed and shipped complete with battery, on receipt of price. This is an admirable chance for local supply houses to influence and develop local trade.

ELECTRICAL WORK AT ST. JOSEPH, MO.

Mr. M. T. Van Brunt, of the St. Joseph Traction & Lighting Company, has accepted a franchise granting him the right to construct and operate a steam heating plant. They intend utilizing their exhaust steam for this purpose. The plant is to be in operation by Oct. 1st, 1895.

A road to Lake Contrary and St. George is strongly talked of by the street railway people there. They have a franchise to construct a road to St. George and if they can get it extended to Lake Contrary, work will be commenced at once.

J. LANG & Co., the well known builders of steam and electrical specialties at 44 Michigan street, Chicago, have just shipped one of their three pole throw-over switches of 1000 amps.; two three pole throw over switches of 150 amps. each; two three pole station switches of 400 amps. each, three three pole switches of 300 amps. each, for the Chamber of Commerce, Detroit. They have also shipped within the last few days with bus bars, etc., complete, a switch of 3000 amps. to handle a machine for the electrical treatment of refractory ores. Electrical men who have seen it say it is one of the finest they ever came across.

PRES. RHOTEHAMEL of the Columbia Incandescent Lamp Company, St. Louis, does not seem in the least discouraged about the prospects of prices being cut, believing that a first class lamp such as the Columbia will always command a good price. The Columbia Company is now adding a 90 K. W. alternator, a 150 H. P. engine and 200 H. P boiler capacity to its equipment, and is also increasing its capacity in all departments so that within thirty days the works will have a daily capacity of ten thousand lamps.

SHULTZ BELTING CO., ST. LOUIS.—Capt. Shultz says "there is nothing like leather" especially the Shultz kind. His company last week belted up the Ottumwa, Ia., plant, the main belt being 86 inches wide. They recently shipped two large belts to Monterey, Mexico, 5,000 ft. to London, England and 5,000 feet to Malmö, Sweden, showing that the fame of their belting is by no means confined to the United States.

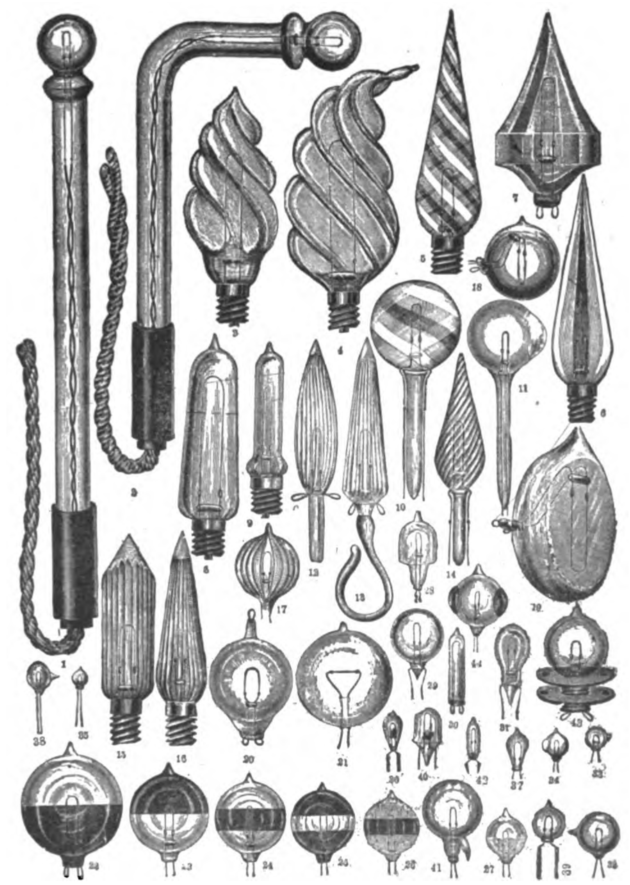
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NOVELTIES IN MINIATURE INCANDESCENT LAMPS.

We illustrate in the accompanying engravings some of the new styles of miniature lamps manufactured by Mr. J. L. Somoff, 11 Park Row, New York City. Figs. 3 and 4 represent lamps for house lighting and are made up to 52 volts, 8 C. P. The shape of the bulbs is like that of flames and the corrugations tend to increase the effect and widen the luminous surfaces of carbon. No. 7 is another lamp for house lighting designed to accord with the style of wall brackets and chandeliers now so much in use. These three types of lamps have already been in extensive use in Europe. Nos. 8 and 9 are plain crystal vari-colored lamps imitating wax candles on Christmas trees.

Of decorative lamps there is quite a variety. Nos. 10 to 14 are made for special use in theatres. The lamps having glass stems instead of the ordinary screw mounting, are mounted



SOMOFF'S MINIATURE LAMPS.

upon the dress of a stage dancer, where a socket would be too heavy to be conveniently used. The lamp stems are stuck into narrow, deep leather pockets specially made, where they seat firmly. These lamps were used last year in the Garden Theatre in New York, mounted in the manner described upon broad turtle shell hair combs of five dancers, eight on each comb. No. 10 has strips of red, blue and white colored glass (natural colors) twisting around the globe; No. 11 has a condensing lens fused on to the globe which condenses the light into a powerful beam. Nos. 12, 13, and 14 have finely corrugated globes, the same as No. 17, which reflect and deflect the light until the whole globe appears to emit light. Miss Dorothy Denning who appeared some time ago at Koster and Bial's had amongst the 350 lights upon her dress—all of Mr. Somoff's make—65 represented in Fig. 13. These were dangling from the edges of her sleeves like flying lights. Nos. 5 and 6 are multicolored, striped lamps like No. 10.

Figs. 22 to 27 present a series of quite unique lamps designed for the dresses of stage dancers. The lamps consist of two or three differently colored segments (natural colors). Thus, when No. 22, having its lower half blue and its upper half crystal is mounted upon an American flag or shield, it will appear like a dazzling star and at the same time color the field blue.

Two hundred of such Somoff lamps have been mounted upon the dress of the well-known actress Miss Hattie Harvey. The most striking peculiarity in this case was that the public saw and counted them as over 500 in number. This deceptive effect was due not only to each of the two or three colors of each lamp appearing as an independent lamp, but, besides, whenever a lamp happened to be back of another one the combination of two colors produce a new one, say violet, when red and blue were on the same line of sight. No. 43 has a hard rubber base designed for a buttonhole, also for stage use.

Of surgical lamps Mr. Somoff makes quite a variety. The demand for them is growing rapidly and the necessity for them is quite obvious; for there are diseases which cannot be correctly diagnosed except with the aid of an illuminating instrument such as the endoscope, cystoscope or a stomach lamp. Here Nos. 1 and 2 are aseptic lamps for the examination of throat and larnyx. These lamps are made wholly of heavy glass and so can be easily disinfected; no other kind of lamp can be safely used for the same purpose when a patient is suffering from an infectious disease. Nos. 28 to 31 and 40 are lamps for laryngoscopes; Nos. 32, 38 and 39 are the illuminants of endoscopic instruments; Nos. 36, 37 and 42 are cystoscope lamps and 34 and 44 are dental lamps, respectively, with one and two lenses fused on to the globes. These lenses have different focal lengths and this arrangement enables the dentist the easier to adjust and direct the beam of light upon a certain spot.

RUMSEY'S ELECTRICAL MANUFACTURERS CO.

Under the above striking name a new concern has been organized in Philadelphia, with offices at 1217 Filbert street and warerooms at West Philadelphia. The company has been formed by George A. Rumsey, formerly assistant manager of the Wilmington, Del. City Electric Light Co., and E. A. Rumsey, the superintendent of the Pittston, Pa., Citizens Electric Ill. Co. Their experience on the operating side of the business has therefore qualified them to judge and handle goods discriminatingly, and they have moreover the good fortune to have associated with them Mr. C. W. Putnam, formerly of the Campbell Co., and well known as a shrewd and successful outdoor representative. The concern will carry on a business both as consulting engineers and as manufacturers' agents. Their sales department has the agency for New Jersey, Maryland, Delaware and Eastern Pennsylvania of the following goods: The wires and house supplies of the Ansonia Electric Co.; the carbon products of the Crouse-Tremaine Carbon Co. (and their motor brushes outside Philadelphia); George Cutter's celebrated electrical specialties; Haight & Clark trolley harps and wheels; Michigan Electric Co.'s railway supplies; Paranite lamp cord, wire cables and tapes; Century paint and tape; Samson trolley and arc lamp cord; Steel Motor Co.'s, excellent railway specialties and details; Packard incandescent lamps; poles, cross arms, pins, brackets, etc. The company will be glad to hear from any likely purchasers within its territory and guarantees a prompt delivery of satisfactory goods in any line enumerated.

WESTINGHOUSE TWO-PHASE PLANT AT THE SOLVAY PROCESS WORKS, SYRACUSE.

The Westinghouse Co. have just installed a complete incandescent, arc and power distribution plant of the two-phase alternating type at the Works of the Solvay Process Co., at Syracuse. The plant consists of two 100 H. P. 2-phase alternators operating at 7200 alternations, direct connected to Westinghouse engines. About 1500 incandescent and 80 arc lamps are run direct off the circuits and four 2-phase motors ranging from 3 to 30 H. P. distribute power. The distance covered is about a mile and the entire installation has worked admirably since the beginning. It is proposed to increase the plant in the near future.

ATTIX WIRE AND THE FIRE UNDERWRITERS.

AT a meeting of the New York Board of Fire Underwriters held on March 20, the following resolution was adopted:

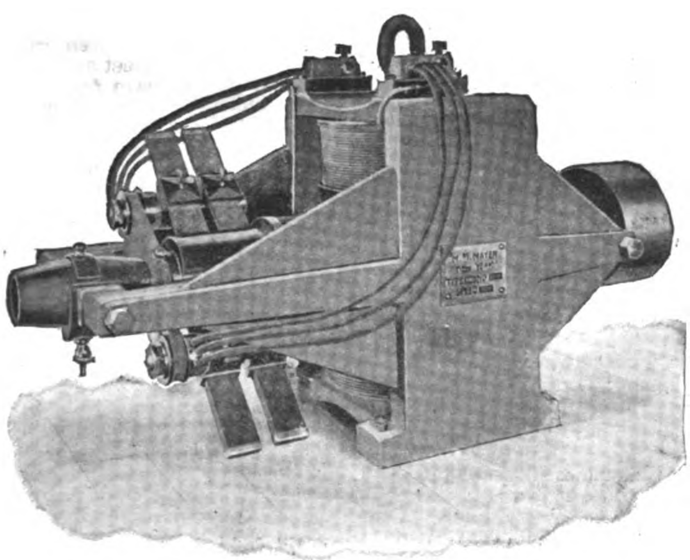
Resolved, "That the Superintendent be authorized, until further notice, to approve the use of the Attix tube and wire, when equal in quality and insulation to the samples submitted to this Board and tested, under the same conditions where tubing would be permitted; provided that there is no splicing or tapping of the wire, but that its introduction shall be in all cases by the loop system; and that in new buildings when necessary to carry it between floor and plastering it shall be through holes bored in the beams, not less than two inches apart, a single conductor in each hole, out of the reach of nails; and in old buildings where necessary to carry it within the reach of nails it shall be protected by some device from perforation; and provided further that the wire and tube be carried intact into the cut-out boxes, and that in no case shall the outer covering be removed before introducing the core wire into the cut-out box."

THE MAYER DYNAMOS AND MOTORS.

THE accompanying engraving illustrates the type of machine just brought out by Mr. Maxwell M. Mayer, of this city, for lighting, power, and plating purposes.

As our illustration shows, these machines are of the favorite two pole iron clad type with the magnets in a vertical position. The field frame is cast in one piece of the best steel casting from which results equal to the best wrought iron are obtained. These machines have a small leakage factor, there being no external magnetism and the leakage on the inside of the frame being reduced to a very small amount.

The armatures are of the Siemens drum type, of comparatively large diameter, the cores being finely laminated to prevent the generation of eddy currents. The wires are wound in slots milled into the core, thus preventing displacement due to centrifugal force. The coils are wound in alternate sections, connecting a long and short coil, thus balancing the armatures electrically. The winding is open to allow perfect ventilation, the wires being separately taped to protect them from injury. The magnetic circuit has high permeability owing to the reluctance of the air space being very small due to the teeth in the armature core which are kept at a very low induction, so as to fully utilise both the magnetic and mechanical advantages of toothed cores. This combination together with the small ohmic loss, absence of eddy currents, etc., in the armatures, makes these machines very efficient. Sparking is prevented by having the field much more powerful magnetically at all loads than the armature, thus over-



MAYER DYNAMO AND MOTOR.

powering the reactions of the latter and consequent displacement of the neutral line. The dynamos being shunt wound makes them practically automatic and prevents the plating dynamos from reversing.

The mechanical details have been very carefully worked out. The brackets are supported by arms which are cast with the steel frames and are bored out with the pole pieces, thus securing perfect alignment. The commutators are of tempered copper insulated with mica throughout. The contact and wearing surfaces of the commutators and brushes are exceptionally large which is very important with low voltage and high amperage dynamos. The light dynamos and motors have carbon brushes, gauze brushes being used for the plating dynamos.

Although this is a new line of machines Mr. Mayer is placing upon the market, hundreds of his machines, especially for plating purposes previously designed by him, are in daily use. He is now fully equipped to turn out his new machines in a systematic manner, all the work being under his personal supervision. The offices and factory are located at 409 107th St., East River, New York.

NEW ENGLAND NOTES.

THE ELECTRIC HEAT ALARM CO. of Boston, have issued an extremely handsome catalogue of their system of heat alarm, as applied to buildings, shafting, grain elevators, etc., right up to date. It embraces everything in the thermostat line, and gives a thorough description of how to protect buildings, the best method of wiring, how to connect with fire alarm stations, etc., etc., and is altogether a most valuable treatise on the subject of fire protection. In addition the outside cover of the book is arranged as a calendar with supports on the back, so that it forms also a useful adjunct to every businessman's desk. Our readers should send for one and see that they get it; they will appreciate it.

BOSTON, MASS.—The committee on taxation gave a hearing on a bill introduced by Mr. Bliss of West Springfield to place a tax on the sub companies of the American Bell telephone system.

WEST END EMPLOYEES have been objecting to the carriage of mails on the cars because it gives the road the protection of government troops in times of trouble.

THE HOLTZER CABOT ELECTRIC CO. of Boston, are out with a handsome new catalogue which embraces everything electrical from a push button to a dynamo or electric motor. There are some good new things in it too, which cannot be described in this column, but which all electrical engineers ought to know about. Their starting boxes and rheostats, with automatic throw off, their motor generators and their 1895 alternating fan motors are particularly interesting, and should be investigated.

THE DEANE STEAM PUMP CO. have issued from their Holyoke, Mass., headquarters, a series of most interesting little brochures on the details of their business, each pamphlet illustrating and describing some of their leading machines and specialties. A copy will be mailed to any address on application. One relates to their automatic receiver; one to their triplex power pumps; one to the Deane specialties and another to apparatus for artesian wells.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has lately completed for the town of Barrington, R. I,, an iron bridge 350 ft. long and 20 ft. wide. The Bonta Plate Glass Co., of Scranton, Pa., has placed the contract for its handsome new building with the Berlin Iron Bridge Co. The building will be 140 ft. wide and 1144 ft. long, covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering.

MR. EDWARD P. SHARP, recently connected with the American Mica Co., of Boston, has established himself as a manufacturers' agent, at 44 Niagara street, Buffalo, N. Y., and will hereafter represent in that section of the country the following companies:—Beacon Vacuum Pump & Electrical Co., incandescent lamps; Bradford, Kyle & Co., magnet wire; Taunton Locomotive Mfg. Co., snow plows; American Mica Co., mica; Shawmut Fuse Wire Co., fuse wire; R. D. Nuttall, railroad supplies; Spinney & Virtue, hand rubber and tape; Sampson Cordage Co., cord; and Partridge Carbon Co., carbons. Mr. Sharp has travelled through this section for years, making Boston his headquarters, and now that he has established himself in Buffalo, there is no doubt that he will work up a good business, as he has hosts of friends in the trade.

BIBBER, WHITE & CO., have opened a handsome and commodious office at 620 Atlantic avenue, under the charge of Mr. C. E. Bibber, a gentleman who requires no introduction to the electrical trade, being well known from Maine to California, and from the Provinces to the Gulf. They are sole selling agents of the wires and cables manufactured by the Crefield Electric Works, Pawtucket, R. I., who have already established a good reputation for the excellent quality of their magnet, office and annunciator wire. They are also New England agents for the well known specialties of the Cutter Electric & Mf'g. Co. of Philadelphia, and carry a full line of flush switches, and other goods manufactured by this company. They expect soon to have a rubber covered wire on the market, and are now selling Canvasite wire, and all kinds of special conductors and insulations.

THE BEACON VACUUM PUMP AND ELECTRICAL CO. are rapidly increasing their output of the old reliable and popular Beacon lamp, having now stopped entirely the manufacture of the new Beacon. This latter lamp served them well during the stressful days of litigation, but no one will deny that an all glass lamp is better, and as the old Beacon used to be one of the most successful lamps in the market, there is no reason why it should not again become one of *the* lamps. They are increasing the capacity of the factory, and by the fall when the busy season commences, they will have ample capacity for manufacturing 10,000 lamps a day. The Beacon Co. manufacture lamps from 16 to 300 candlepower, and can and will make any other special incandescent lamp known to the trade, or ever before manufactured,—in fact any incandescent lamp that admits of construction. The Beacon Co., invite all users of incandescent lamps, whether customers or not, to call and inspect their works, and the writer, judging from a recent visit, can assure any one who accepts the invitation, that they will see much of absorbing interest. The Beacon Co., would also like to see another test by some disinterested, thoroughly qualified person, of all the incandescent lamps in general use, for life, efficiency, maintenance of candlepower, and freedom from blackening, and feel confident that the Beacon lamp in such a test would well uphold its reputation.

CANADIAN NOTES.

OTTAWA PORCELAIN AND CARBON CO., LTD. The provisional directors of the Ottawa Porcelain and Carbon Co. Ltd., have met and elected officers. President, T. Ahearn; vice-president, Thos. Birkett; secretary-treasurer, J. D. Fraser; general manager, J. W. Taylor, solicitor, E. F. Burritt.

NEW YORK NOTES.

MR. H. T. MORSE has been appointed receiver of the Long Island Traction Co. and an assessment of $2 per share levied.

MR. A. K. BONTA, of the Hudson Electric Light Co., Hoboken, N. J., is introducing a new street car brake of which the newspapers make good reports.

PROF. F. B. CROCKER delivered at Columbia College last week the first of his popular lectures on the utilization of electricity. It was attended by a large audience and was very well received.

MR. GEO. F. SANDT has resigned his position as Secretary and Treasurer of The Electrical and Mechanical Engineering Co. His intentions are to remain in the electrical field. His address for the present is Westfield, N. J.

THE NEW YORK & NEW JERSEY TELEPHONE Co. shows the gross earnings for 1894 to have been $1,252 508.83; the operating expenses, $804,564.89; the fixed charges, $103,027.91; net earnings for this year, $344,914.50. Surplus, December 31, 1894, $837,569.44.

A BUFFALO EXHIBIT.—The Builders' Exchange Association of Buffalo have decided to open a permanent exchange of builders' supplies and material in the ground floor of their building, all exhibits to be in charge of a superintendent. It is believed that there are many electrical specialties that should be included.

THE ELECTRIC CONSTRUCTION AND SUPPLY COMPANY of New York City has been formed with a capital stock of $12,000. Directors: Arthur A. Lawrence and Charles F. Parmly of New York City; W. S. Perry of Staten Island and Charles E. Rocap and Frank E. Kinsman of Plainfield, N. J.

MR W. A. STADELMAN, E. E., has installed himself comfortably at Room 715 Havemeyer Building, as Eastern Agent for the Elwell-Parker Electric Co. of America and the Brown Hoisting and Conveying Machine Co., both of which concerns have their headquarters in Cleveland, O. Mr. Stadelman will be glad to quote on all classes of dynamos, motors, etc.

AUBURN, N. Y., will now have its electric road, by decision of the court over the objection of a few obstructionists; and the public is simply delighted. The line will run to the fair grounds and the lake, and various plans for recreation and amusement are proposed. The company has already got a large quantity of material on the ground.

THE ELECTRICAL MAINTENANCE Co., of 50 Broadway, are making a specialty of the inspection and repair of electrical plants and apparatus; and will also give advice on the management. It is not an insurance company but does the work by contract by the year. The president is E. R. Johnes; treasurer G. H. Cook; secretary R. L Johnson, and general manager J. J. McKenna.

HAMBURG, N. Y.—The Hamburg Railway Company has been formed to build and operate a street surface railroad for a distance of one mile from Woodlawn Beach, a summer resort on the shores of Lake Erie, to the Village of Blasdell, Erie County; capital, $10,000. Directors—James E. Curtis, John O'Brien, William Ellwood, Rollin L Banta, Lafayette L. Long, W. W. Browne, H. B. Butterfield, and D. W. Allen of Buffalo, and Frank D. Caldwell of West Seneca.

MR. TIMOTHY W. SPRAGUE, S. B., after a connection of five years with the power and mining department of the General Electric Company and its predecessor, the Thomson-Houston Company, and a year with Westinghouse, Church, Kerr & Company, has opened offices at 58 State street, Boston, and 253 Broadway, New York, as a consulting engineer. Mr. Sprague will make a specialty of power transmission for mines, and will undertake the drawing up of specifications, after examination, for haulage, coal cutting, pumping and ventilation, as well as reports, supervision of installations and general engineering work. Mr. Sprague is a graduate of the Massachusetts Institute of Technology, and his long and varied experience renders him peculiarly well fitted for the exacting requirements of the work to which he has now devoted himself.

PHILADELPHIA NOTES.

MR. G. H. S. YOUNG, formerly manager of the Philadelphia office of the C. & C. Electric Co., has established himself at 41 North Seventh Street, Philadelphia, as an independent electrical engineer, contractor and dealer in electrical supplies.

THE GERSON ELECTRICAL MFG. Co., of 150 Broadway, New York, has issued a neat and forcible brochure entitled "Some Philadelphia Men of Letters," comparing its telephonic apparatus with that of other concerns on a statistical basis, and giving a number of testimonials from business men in the Quaker city, as well as elsewhere.

WESTERN NOTES.

ST. JOSEPH, MO., is to have a class connected with the National School of Electricity. Milwaukee is also forming a class.

MR. THOS. C. PERKINS, Vice President of the Mather Electric Company, was in Chicago on a short business trip last week.

ANDERSON, IND.—The City Council has granted a franchise to the Harrison Telephone Co. and an exchange will be established at once.

H. P. BROUGHTON, Contracting Engineer, St. Louis, is busy getting out specifications for the electrical equipment of several large buildings about to be erected this spring.

THE AMERICAN ELECTRICAL MFG. Co., St. Louis, have recently doubled their factory capacity and are now better than ever prepared to make prompt shipments of their well known "American" lamps.

THE WALKER MFG. Co. through their Chicago representatives, Messrs. Kohler Bros., were successful last week in securing an order for a large number of car equipments from the Union Depot Railway Company, St. Louis.

OTTAWA, ILL.—The City Council has, partially at least, carried out its threat of annulling the electric street railway company's franchise, by passing an ordinance forfeiting the franchise so far as it relates to the south side system.

THE UNION BRASS MFG. Co., Chicago, confessed judgment in the Circuit Court on the 20th inst. to several banks and private individuals, the amount of judgments aggregating over twenty-seven thousand dollars.

ROCKFORD, ILL.—The possibility of a telephone franchise being granted to a competing company, has induced the Rockford Bell Company to reduce its rates from $48 to $42 for business houses and from $36 to $30 per year for residences.

BLOOMINGTON, ILL.—The power house of the Electric Light and Power Company, which had just been equipped with a new power plant, was totally destroyed by fire on the 18th inst. The loss is $50,000, half covered by insurance.

FREMONT, NEB.—The Fremont Gas & Electric Light Co. has enjoined the building of a proposed city plant. Pawnee City, Neb., is to buy out the local plant and operate it with the waterworks.

THE ELECTRIC APPLIANCE COMPANY are doing a splendid business on "O. K." weatherproof and are laying in an exceptionally large stock for the coming spring business. They claim to be in a position to ship a weatherproof wire order of any size from Chicago stock immediately on receipt.

KROELL & MEYSENBERG, St. Louis, although established but a short time, have already enough engineering contracts in hand to keep them pretty busy. A lighting and power plant being installed by them at Grafton, Ills., will soon be completed and promises to be a model plant of its kind.

MESSRS. PIERCE & RICHARDSON, the electrical engineers, of this city, have begun in the *Insurance Post* a series of articles on the National Electrical Code, in which they discuss the code section by section, considering electricity only as it may or may not create a hazard. The treatment is simple and lucid, and will be very helpful to insurance men not familiar with electrical matters.

THE MATHER ELECTRIC Co., of Manchester, Conn., have secured through Mr. J. Holt Gates of Chicago, their well-known Western contractor, the order for five 100 K. W. multipolar generators, with station equipment, for the new station of the Indiana Electric Railway Co., at Goshen, Ind. This contract was secured against the strongest competition.

MARION, IND.—The Marion Street Railroad, an electric line leading from Marion to several of the gas towns, has been ordered sold by Judge Baker, of the Federal Court. The owner and projector of the line is Russell B. Harrison, son of the ex-President. It is said to have cost $53,000, but debts have been incurred to the amount of $80,000, the bonded debt being $75,000

THE MISSOURI WATER, GAS & ELECTRIC ASSOCIATION has been formed. Sedalia is to be the permanent place of annual meeting. The officers are: President, W. E. Walton, Butler; vice president, James A. Montgomery, Sedalia; secretary, C. F. Strohm, Nevada; treasurer, R. D. Wirt, Independence. Executive committee: The officers of the association, and F. J. Taggart, Butler; J. M. Hume, Boonville; J. F. Marsh, Clinton. Legislative Committee: J. B. Quigley, Sedalia; W. E. Walton, Butler; W. C. Hornbeck, Springfield.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. APRIL 3, 1895. No. 361.

STAGES AND TYPES OF THE TESLA OSCILLATOR.

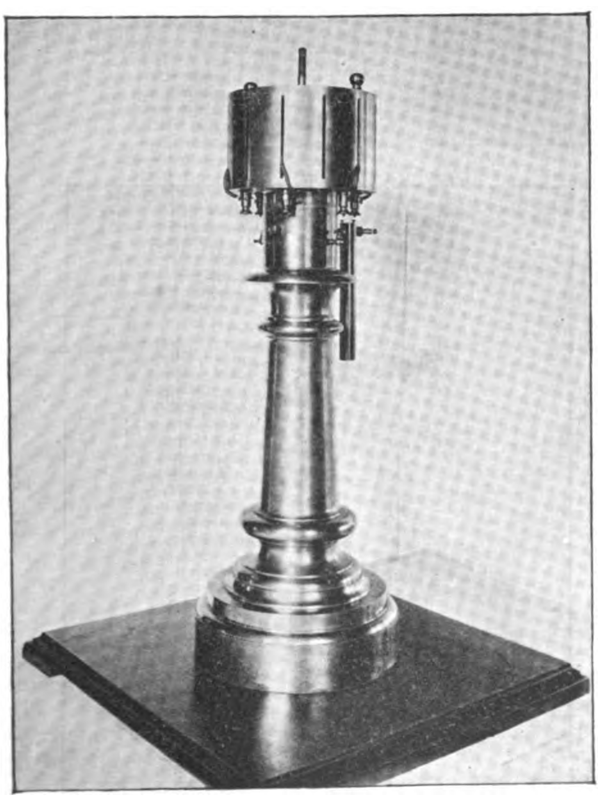
Tesla Coil Demonstrating Earth's Electrical Charge (Sketched from April Century). Fig. 9.

THE recent destruction by fire of the building in New York City in which Mr. Tesla's laboratory was situated, and the consequent wreck of all his valuable apparatus, lends special value to the illustrations herewith, never before shown, of a number of Tesla oscillators. It will interest our readers to know that the engravings were made about a year ago, but were laid aside awaiting the completion of other and later work, all of which Mr. Tesla proposed to bring in rounded shape before one or other of the scientific societies, accompanied by actual demonstrations with the machinery. Fate has willed otherwise, and these pictures are practically all that can now be shown, except the engraving secured by the *Century Magazine* of the latest "double oscillator" and printed by that publication in its April issue. In view of the fire, it becomes proper and desirable to bring these machines to general notice, and we have obtained Mr. Tesla's consent to our doing so at this juncture.

In order to render the series of Tesla oscillators in some degree complete and consecutive, we have reproduced here from THE ELECTRICAL ENGINEER of Nov. 8, 1893, the cut of one of the machines shown before the Electrical Congress, at Chicago, using compressed air as the working fluid (Fig. 1.) It will be remembered that the principle involved in the oscillator is that of oscillating a coil or magnet, with great economy of energy, in an intense field, and thus generating current on terms of very high efficiency and regularity, as well as with marked diminution in size and weight of apparatus. The engine resolves itself down to a chest or cylinder for the working fluid and the piston for carrying the armature. The article in the ENGINEER to which we have referred above gives a number of details, with a diagram, and other data will be found in Mr. Martin's work on Mr. Tesla's inventions.

Fig. 2 was one of the oscillators shown at Chicago in August, 1893. It was actuated by compressed air there during the lecture delivered by Mr. Tesla. The machine consists of an engine mounted on an ornamental column, carrying on top a generator similar to that shown in E of Fig. 7.

An analogous form is shown in Fig. 3, without the generator. In the box on top of the column there is a



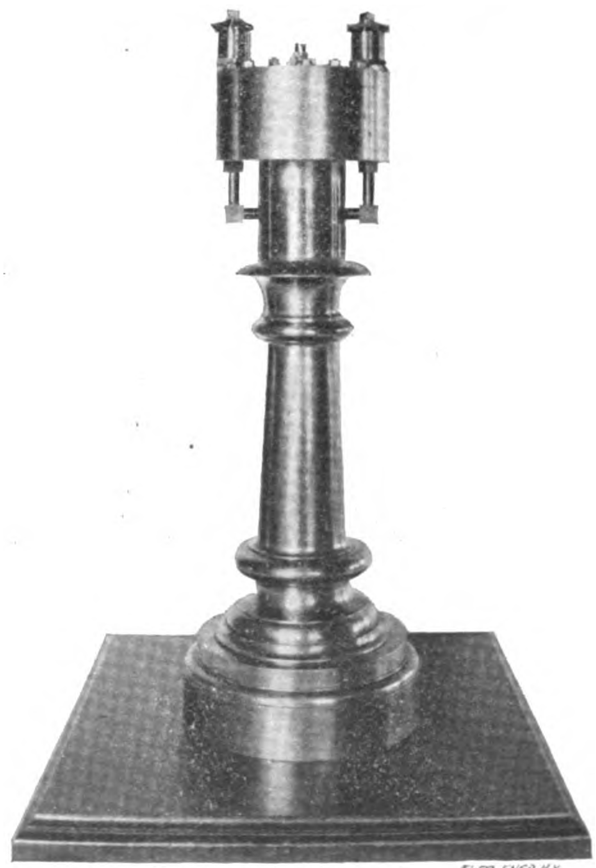


FIG. 2. TYPES OF TESLA OSCILLATOR. FIG. 3.

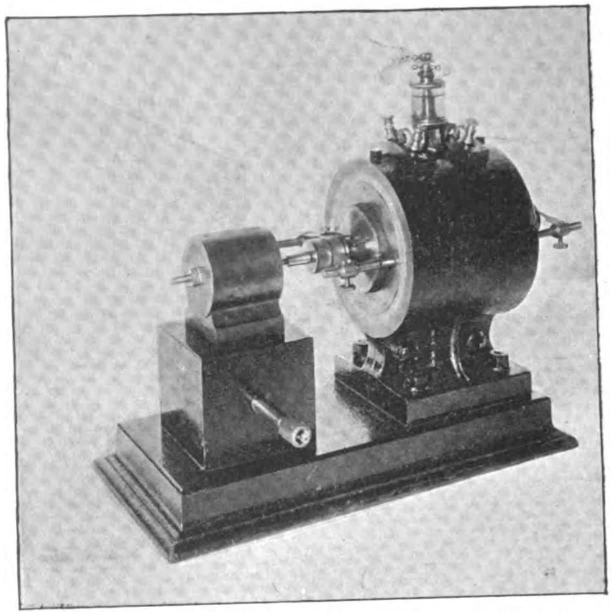


Fig. 4.

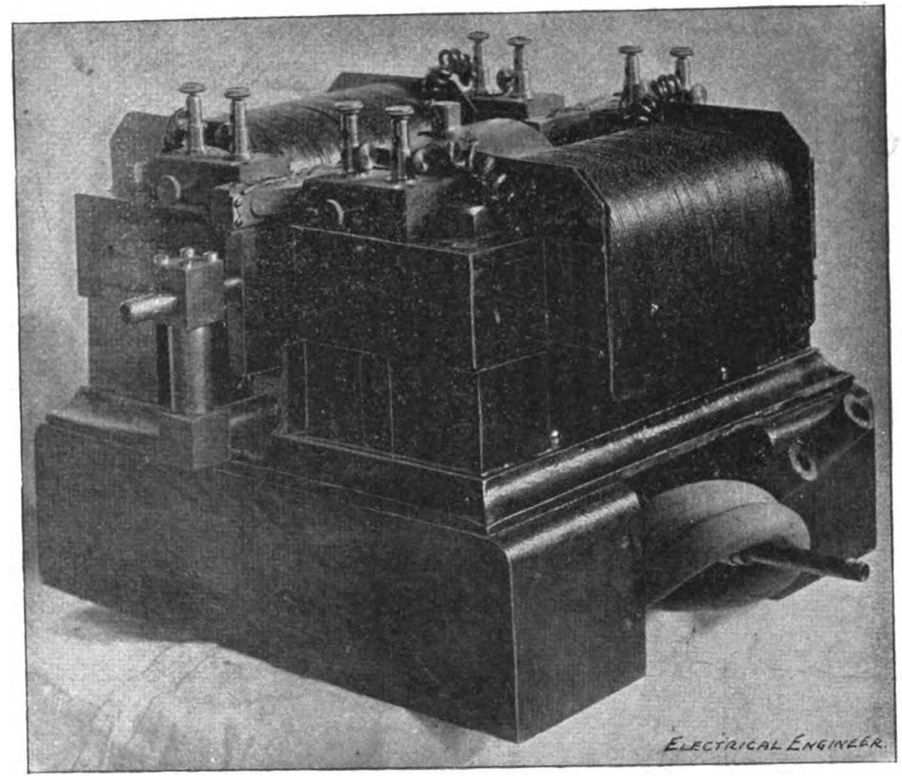


Fig. 1.

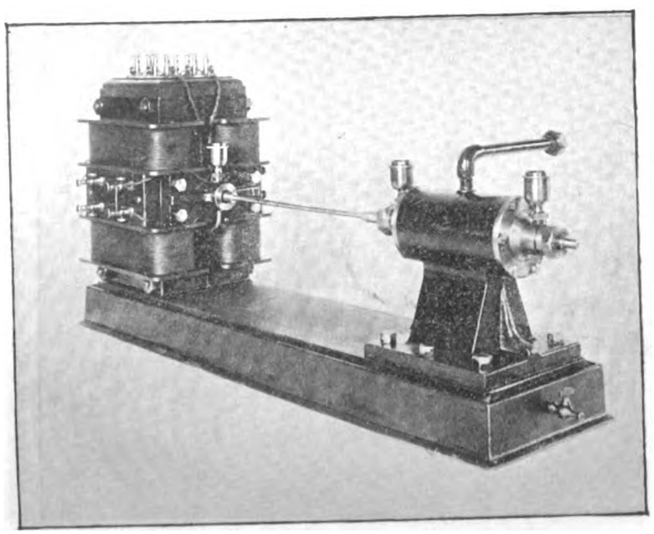


Fig. 5.

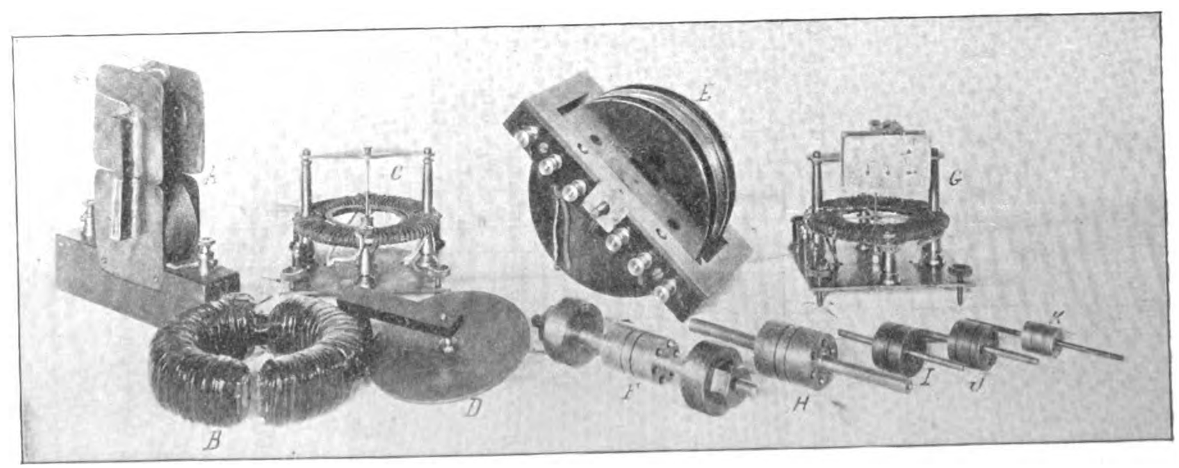


Fig. 7.

Types and Details of Tesla Oscillators.

Lent by THE CENTURY CO.

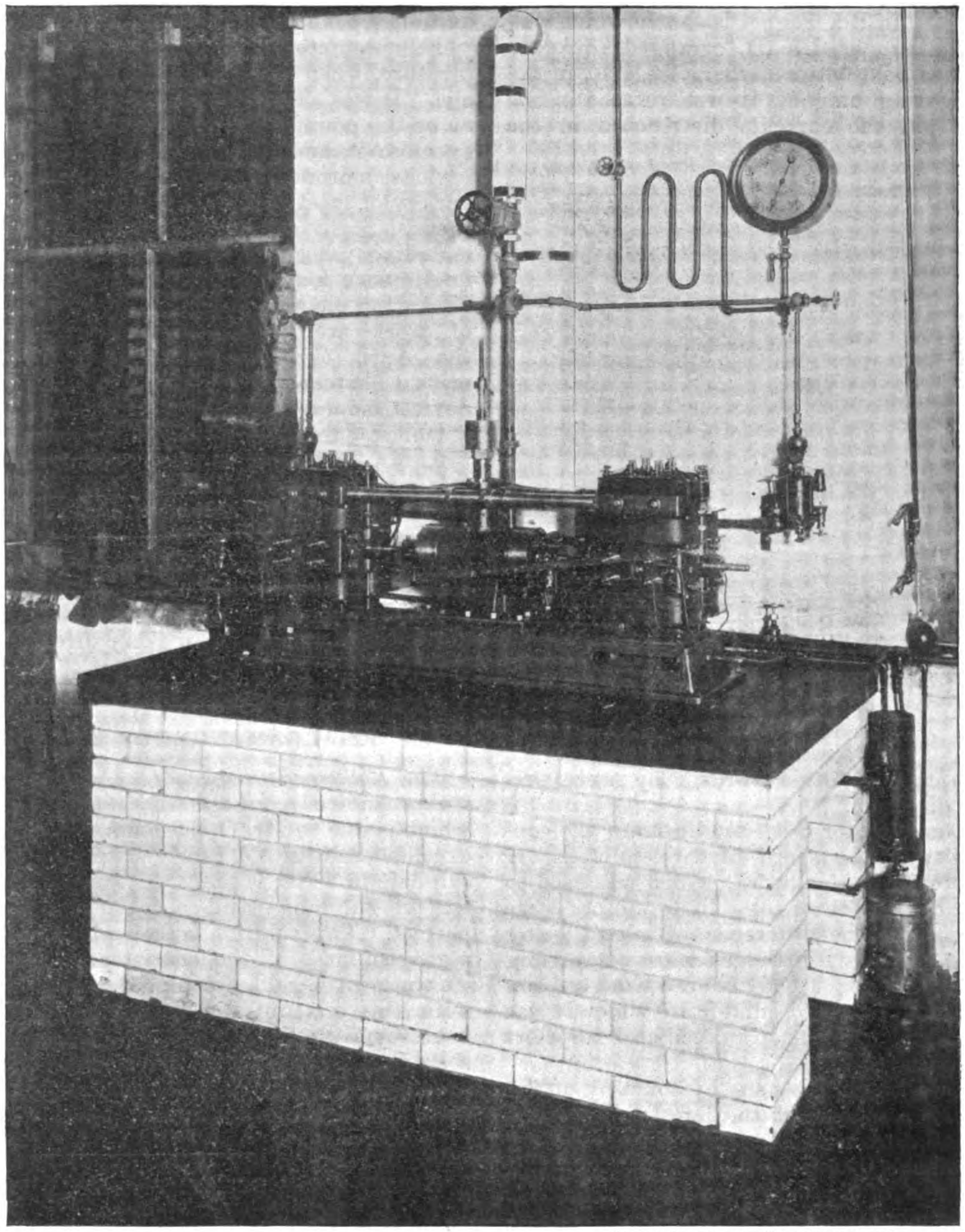


FIG. 8.—RECENT FORM OF TESLA OSCILLATOR.

very strong air spring. The construction is such that the engine is always in exact synchronism with the vibrations of this spring. The engine can do nothing else but keep the spring vibrating, and eventually will alter the amplitude of the vibration, but the period remains the same, i. e., it is the natural period of vibration of the system. The recoil of the spring is, of course, incomparably greater than the impulse received each time from the engine. There is a chamber around the spring which can be maintained at a constant temperature by any usual means. As the frictional losses are vanishingly small compared with the enormous elastic force, the isochronism is perfect.

In Fig. 4, another quite distinct type is shown. A small oscillator is mounted on a stand with a dynamo of somewhat unconventional form. This dynamo comprises a circular field magnet in which are arranged to move on each side circular coils. The coils are carried by an arbor which is connected directly to the little engine ; and the currents are produced by vibrating the coils within the field of the magnet. In this form, Mr. Tesla says, there is absolutely no useless wire, as all of it is within the field and all equally active.

In Fig. 5, a more advanced form of oscillator is shown, operated by steam and freely used for laboratory purposes. This minute machine had a capacity of 12 lights. It consisted of a small oscillator and a dynamo, the latter comprising a field magnet with its exciting coils and an armature merely of iron. The magnet had on its inside a number of pole projections upon which the induced coils were wound. The armature had projections of lesser number than those of the field. In this way the output of the dynamo was increased, by the number of teeth.

In Fig. 6 we have an interesting experimental apparatus consisting of a field magnet within which there is arranged to vibrate a tongue of steel carrying on its end a coil. This tongue and coil were vibrated in the strong field. There were adjusting screws on each side which allowed the attainment of any periodicity, within wide limits. This apparatus was used for scientific research solely.

Fig. 7 comprises a most interesting group of parts which were shown by Mr. Tesla in his demonstrations. Several of the instruments were used for the exemplification of novel features. The magnets in A, for example, were used to elucidate the principle of the preponderance of one impulse over the other in the current produced by

the oscillator and creating virtually the effect of a direct or continuous current. In B a magnet is shown which was vibrated. When the copper disc D, arranged to rotate freely in bearings, was held between the poles, i. e., in the field of the vibrating ring magnet, it was rotated in one direction, showing that the currents distributed in the

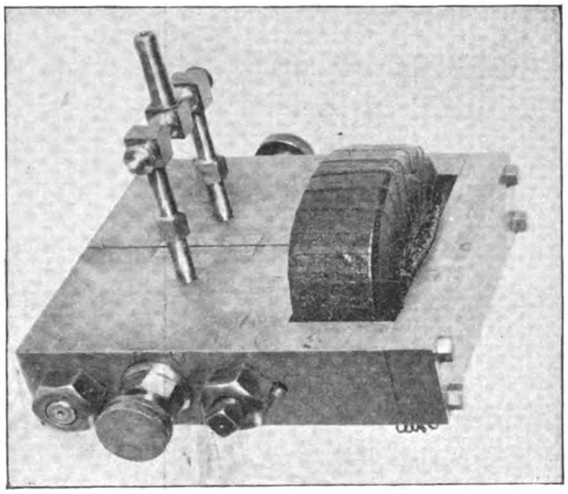
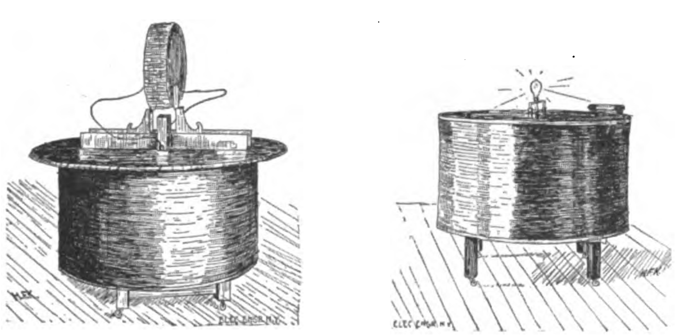


FIG. 6.

disc were asymmetrical. In other words, they were preponderating in one direction.

C, in Fig. 7, is a little motor used to illustrate the constancy or invariability of the speed of the oscillator. G was also a little motor with clockwork, which was used to count the revolutions. Both of these little motors were driven from one circuit, the difference of phase being obtained artificially. E was a little generator comprising three coils, two inducing and one induced; and an iron coil which was vibrated by the oscillator to which it was attached. F, H, I, J, K, are parts of an oscillator for short and long stroke respectively.

In Fig. 8, which we reproduce here by courtesy of the *Century Magazine*, is seen one of the latest types of the Tesla oscillator. It is a steam mechanism, but the "engine" part may be said to have disappeared, so far as that word implies an aggregation of fly wheel, governors, etc. On the one base were mounted two dynamos, or electromagnetic generating systems and a small steam chest. There were two pistons which were vibrated by the



FIGS. 10 AND 11.—TESLA EXPERIMENTS.
(*Sketched from April Century.*)

steam 80 to 100 times a second. Each of the pistons carried an armature which was plunged reciprocatively into the field of the magnets. Normally the engine was run with the two pistons in opposite phase; but they could be set by an independent device in any phase. Above the chest was mounted an independent little oscillator, which in some experiments controlled the steam admission, and made the vibration of the engine quite independent of the load.

This oscillator was operated with steam at 350 pounds pressure, when it needed no packing, as there was no leakage. It was also used at pressures down to the ordinary 80 or 100 pounds. It was used to light up a bank of 50 or more incandescent lamps, some arc lamps, and to run various motors; while it also furnished current for a variety of most interesting and novel experiments, all of them suggestive of new departures in the electrical arts, including phosphorescent lighting, the transmission of intelligence long distances without wires, the utilization the earth's electrical charge, etc. Some of these branches of work are touched on, in a popular manner, in the April *Century*, from which we have made one or two sketches, in Figs. 9, 10 and 11, illustrative of the devices employed in connection with the oscillator.

Our readers will be glad to know that although, in the fire, Mr. Tesla's apparatus which we have shown above was practically wiped out of existence, the inventor has been most indefatigably at work ever since and will soon have reproduced his oscillator in its latest and most perfect form. There can be no doubt that in this appliance we have a mechanism for the simultaneous utilization of steam and generation of current under conditions that must effect large economies in every direction; while it should also prove a powerful instrument for exhaustive research.

AMALGAMATION OF BATTERY ZINC.

The *Elektrochemische Zeitschrift*, in a recent number, makes known a process of amalgamating battery zincs which is due to Mr. Oppermann, and which is said to give excellent results. A nearly saturated solution of mercuric sulphate in water is prepared, and to it is added the quantity of sulphuric acid necessary to make the solution perfect. This solution is then mixed with oxalic acid until a grayish mass of the consistency of cream is obtained. To this a little sal ammoniac is added. The zinc is coated with this mixture and then vigorously rubbed. It has been found that zinc thus amalgamated resists acids and salts much better than when amalgamated by the ordinary process. If the zinc is not to be used at once, it should be dried before being put away.

WOOD A DOUBLE REFRACTOR FOR HERTZIAN WAVES.

HERR K. MACK, working in the Hohenheim Physical Institute, has succeeded in demonstrating the occurrence of double refraction of electric waves in wood. That electric waves, unlike light waves, are capable of penetrating wood, was already found by Hertz. "It is not without surprise," he says in his classical work on the "Propagation of Electric Force," "that one sees the sparks appear inside a closed room." But the fact that waves of electric force are transmitted in a different manner accordingly as they vibrate across or along the fibre of the wood, has only just been proved by Herr Mack, who gives a full description of his method in a recent number of *Wiedemann's Annalen*. It is well known that two Nicoll prisms transmit no light when their principal plates are crossed, but that light may be made to appear by inserting a doubly-refracting substance between them. For the Nicoll prisms substitute Hertzian concave mirrors with their focal lines crossed, and, instead of the tourmaline or other doubly-refracting substance, insert a plate of wood 10 inches thick, with its fibre at 45° to each of the focal lines, and you have Mack's apparatus. The sparks, which are extinguished on crossing the two focal lines, reappear on inserting the wood in the manner indicated. This striking experiment forms another important link in the chain connecting the domain of light with that of electricity.

ELECTRIC TRANSPORTATION DEPARTMENT.

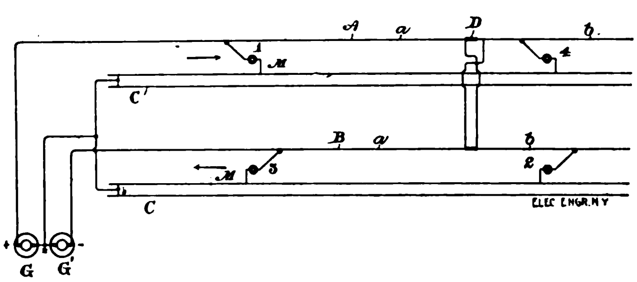
KNIGHT'S THREE-WIRE SYSTEM FOR RAILWAY CONDUCTORS.

We have illustrated and described several electric roads in which the system of three-wire conductors has been put in operation and this method seems to be gradually gaining favor, owing to the copper economy which it permits of. This system, it will be recalled, is so arranged that the trolley wires of a double track road form the outer mains of a three-wire system, the track rails and ground forming the neutral. In practical installations of this character, however, it has been found difficult to preserve the system fairly well balanced, since the load on the different branches of necessity becomes at times very unequal. For example, on a grade, the motors travelling in one direction must take the necessary current to enable them to climb the grade, while the motors travelling in the opposite direction are running light.

To overcome this drawback, Mr. Walter H. Knight, one of the engineers of the General Electric Co., has devised the plan of crossing over the trolley wires of the different tracks at necessary points, so that some of the motors on one track will be coupled between the positive main and the neutral, while others will be coupled between the neutral and the negative main. In this way it will be apparent that the load on any one track may be balanced up as circumstances require between the different branches of the system, instead of balancing the load of one track against the other, as has heretofore been customary.

The manner in which this is carried out will be apparent upon an inspection of the accompanying diagram.

A B represent the trolley wires of the different tracks, which are connected respectively to the positive and negative terminals of a pair of generators G G′ coupled in series in the manner cus-



KNIGHT'S 3-WIRE RAILWAY SYSTEM.

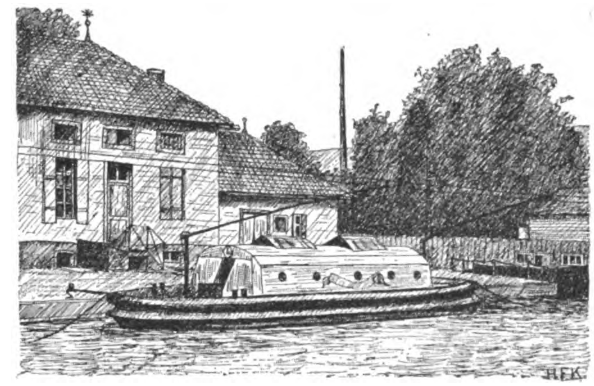
tomary with three-wire systems. The tracks C form the neutral and are connected to the generators, as shown. Motors are represented on the two tracks at M, some of which are supposed to be travelling in one direction and some in the other, as indicated by the arrows. It will be observed that the trolley wires for the respective tracks are divided into insulated sections by section-insulators indicated at D. Section *a* of trolley wire A is connected across to section *b* of trolley wire B, and in a similar manner section *a* of trolley wire B is connected to section *b* of trolley wire A. Hence it will be seen that motors 1 and 2, although traveling on different tracks, are connected between the positive main of the system and the neutral, while motors 3 and 4 are similarly connected between the neutral and the negative main. When any of the motors pass from one section to another of the trolley wire, it at the same time passes from one branch to the other of the system.

ELECTRIC RAILWAY CONSOLIDATION IN CONNECTICUT.

The Consolidated Railroad Company, of Norwalk, Conn., is said, in spite of denials, to be formulating plans to purchase several trolley railroads along its lines in Connecticut, including the Bridgeport Traction, the Norwalk Tramway, the Westport and Saugatuck Horse Railroad Company, the Westport and Southport Tramway Company, and such other street railroads along its lines, the control of which will best serve Consolidated interests. The Consolidated, it is said, has become convinced that the extension of electric roads under old charters and under new ones, for which so many petitions have been presented to the Legislature, will parallel its lines to such an extent as to affect its income from short-distance traffic. The Westport and Saugatuck Horse Railroad Company, with a capital stock of $15,000, divided into 150 shares, has accepted a proposition from the Consolidated which includes the purchase of the stock of the company at par, provided the Legislature allows the company to use electricity. With the Westport and Southport Tramway Company the agreement is that the Consolidated will aid it to obtain the electrical clause to its charter, with the view, of course, of controlling it when secured.

SUCCESSFUL ELECTRICAL CANAL BOAT OPERATION IN FRANCE.

An account was given in The Electrical Engineer of April 11 and June 20, 1894, of the operation of the Canal de Bourgogne



TROLLEY CANAL BOAT OPERATION IN FRANCE.

France, by electricity; and the boat was illustrated. The motor on the boat, taking its current from an overhead trolley line, drives a drum over whose teeth pass the links of a submerged chain, by hauling upon which the boat makes slow headway. The electric motor takes the place of the steam engine. The canal is 3.72 miles long, including a tunnel 11,100 ft. long, with a minimum depth of water of about 7 ft. Electricity, generated by turbines was substituted for steam at a total cost of about $27,000 According to a late report in the "Annales des Ponts et Chaussées," between Sept. 1, 1893, and April 1, 1894, the total traffic hauled was 80,794 tons in 897 working hours, at an expense of $1,180, including $60 for the use of steam towing during some slight repairs. During the same period in the previous year, using steam, the traffic was 78,639 tons, hauled in 917 hours, at a cost of $1,600. For the transport of 1,000 tons, 11.65 hours and $20.40 were required with steam; and with electricity these figures were 11.01 hours and $14. The owners of the canal believe that the new system of operation will be profitable. Details of such methods of chain haulage will be found in the new book on "Electrical Boats and Navigation," from which the accompanying cut is taken.

AN ELECTRIC TRAMWAY OVER NIAGARA.

A special dispatch from Lockport, N. Y. says:—Attorney George W. Pound, one of the directors of the Aerial Tramway Company, has sent to Albany a bill authorizing his company to erect a tower and landing place in the State Reservation Park for the use of a scheme which will be one of the engineering triumphs of the age. A similar one has been obtained with reference to Queen Victoria Park from the Canadian Government. Leading Canadian politicians are interested in the enterprise.

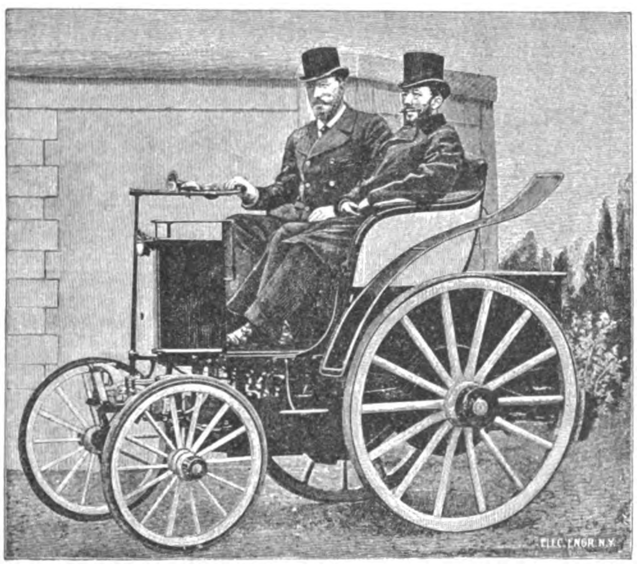
The company proposes to carry tourists across the Niagara River over the brink of the cataract and thirty feet above the raging waters. A double set of cables will be stretched from the towers in the Canadian and American parks, with a supporting tower on Goat Island. On these cables cage-like cars will be suspended by trolleys and operated by electricity from the American side. The aerial line will follow along the brink of the American Falls to Goat Island, and thence to the Canadian shore, forming a cord to the bow of the Horse Shoe Falls. The cars will be of steel, and the cables the best manufactured. The floors of the cars will be perforated or glazed to allow visitors to look below, and the side views will also be unobstructed.

If the bill just sent to the New York Legislature becomes a law, expert engineers will be engaged to superintend the construction. The projectors claim that the aerial tramway line will be as safe as the suspension bridges themselves. Each cable will be independent of the other, and sufficient to sustain ten times the weight of the cars and passengers. The electrical engineer will be able to stop and start the car anywhere on the line. The bill has powerful friends in the Legislature, it is said, and New York will probably follow Canada in giving requisite grants.

THE JEANTAUD ELECTRIC CARRIAGE IN PARIS.

M. CHARLES JEANTAUD, the head of an important carriage establishment of Paris, commenced experimenting on an electric carriage in 1881, when the accumulators of Faure first appeared, but at this time the dead weight of the accumulators was so great that he was forced to stop his experiments; but he was spurred into activity by the recent success of petroleum and steam motors for carriages, and the result of his labors is the electric carriage which we illustrate herewith. He found it necessary to obtain a source of electricity lighter and less cumbersome than those in use. He found it in the "Fulmen" accumulator, recently described in THE ELECTRICAL ENGINEER. The plates are covered by a perforated celluloid envelope filled with the active material. In the center of this envelope are the lead plates which serve to collect the current. The plates are carried in wooden receptacles, which are lined with celluloid. They are composed of two parts, the box proper and the cover, which is absolutely watertight and is transparent as well. The accumulator thus constructed presents a small bulk and light weight compared with its great capacity; it resists perfectly the shocks to which it is subjected. The batteries which propel the carriage of M. Jeantaud consist of 21 elements of the type just described, which give a current of 100 amperes at a pressure of 40 volts. In ascending slopes the current is increased.

The general appearance of the new carriage, as shown in our engraving, resembles that of a petroleum-propelled carriage. None of the actuating mechanism is in sight. The 21 elements are inclosed in seven small boxes, each containing three accumulators. These boxes are stowed away under the seat. The hands are free to steer the carriage and to control the speed; the switch as well as the brake, is controlled by the foot. The foot is placed on the switch and the carriage starts with ease; on removing the foot the carriage stops and the momentum which it has acquired may be checked, if desired, by applying the foot to the brake. The brake is of the ordinary variety, a wooden shoe binding on the rear wheel; a circuit breaker is placed on the brake pedal, so that when the brake is applied the current is cut off at the same time. On a good level road a speed of 20 kilometers (12½ miles) per hour has been obtained, while in a hilly country the speed is reduced to 12 kilometers. The weight of the carriage is distributed as follows: Carriage, 1,078 lbs.: accumulators, 924 lbs.; motor, 242 lbs.; two passengers, 330 to 396 lbs.; total 2,640 lbs.



THE JEANTAUD ELECTRIC CARRIAGE.

SKILLED AMERICAN MOTORMEN.

A bill has been introduced in the New Jersey Legislature providing that none but an American citizen over the age of 21 years shall be employed as a motorman in New Jersey. He must undergo an examination as to his fitness before a board of three motormen selected from among the employees by the superintendent of a road. In order to avoid difficulty in time of strikes, through the refusal of the board to act, the bill provides that in such case the directors of the company may choose three electricians to examine and license motormen. The bill also fixes eleven hours, with forty-five minutes for meals, as a day's work for a motorman.

TELEPHONE.

AMERICAN BELL TELEPHONE COMPANY—15TH ANNUAL REPORT.

At the annual meeting of stockholders, held March 26, the directors presented their yearly report to December 31, 1894—substantially as follows:

EARNINGS.

	1893.	1894.
Rental of telephones	$3.513,711.42	2,502,992.17
Dividends	*1,824.481.98	*1,937,657.77
Commission from Ex-Terr lines	108,621.38	106 939 46
Commission from Teleg. business	29,192.79	29,352.96
Real estate	68,097.06	69,675.09
Interest	225,936 28	196,455.11
Miscellaneous	11,026.08	5,172 38
Totals	$5,781,076.99	4,848,244.94

EXPENSES.

	1893.	1894.
Expenses of operation	$392,770 89	430,340.39
Legal expenses	114,852 47	178,348 88
Real estate	44,532 41	85,798.34
Interest and taxes	300,368.38	356,478 51
Commission	690,380 58	459,958 71
Royalty	10,000.00	5,000 00
Concessions	257,829.92	231,713.64
Miscellaneous	44.857.15	26,827.50
Totals	$1,855.591.30	1,724,459.87

Net earnings	$3,925,485 69	3,123,785.07
Surplus account, Dec. 31, 1893	$2.151,011.61	
Net earnings 1894	3,123,785 07	
		5,274,796.68
Regular dividends 1894	$2,400,000 00	
Extra dividends 1894	600.000 00	
Reserve for depreciation of insts	123,785.07	
		3,123,785.07
Surplus account, Dec. 31, 1894		$2,151,011.61

* No portion of the earnings of the Metropolitan Telephone and Telegraph Company was divided.

BALANCE SHEET.

ASSETS.

Telephones	$1,209,787
Real Estate	950,926
Stocks	38,268,455
Mdse. and Mach	14.232
Bills and acc rec	4,355,554
Cash and deposits	760,776
Total	$45,559,733

LIABILITIES.

Capital stock	$20,000,000
Deb bonds, 1888	2,000,000
Bills and acc pay	*1,107,949
Pat acc (pr and loss)	10,228 571
Profit and loss	5,819 444
Reserve	4,222,756
Surplus	2,151,011
Total	$45,559,733

*Of this amount $900,000 is for the dividends payable Jan. 15, 1895, to stock of record Dec. 31, 1894.

In his report Pres. Hudson says: "In comparing the gain in the output of telephones for the year 1894 over that of the year 1893—16,015 telephones for 1894, as against 13,771 in 1893—attention should be called to the fact that in the months of January and February the returns exceeded the output by 3472, so that the actual growth in number of telephones during the remaining 10 months would be little short of 20,000 instruments.

"A greater mileage of toll wires has been added than in any previous year in the history of the business.

"Not including the cost of current repairs and renewals, the companies operating under our licenses have expended, during 1894, upon extensions of lines and apparatus, $4,138,000, and for buildings to accommodate their exchanges $411,000, making, with the amount reported last year, a total of investment in telephone property in the United States of $77,500,000.

"The construction department reports that the total of lines Dec. 31, 1894, was 4617.24 miles of pole line and cables and 75,555.72 miles of wire. Of this there were constructed during the year 633.26 miles of pole line and 9379.71 miles of wire.

"The metallic circuit system has grown rapidly in favor, and at the close of the year the stations of 54,680 exchange subscribers were furnished with the equipment for this improved class of service, a gain during the year of 17,083.

"The steadily increasing use which subscribers make of the exchange service, continues to be a noticeable feature of the statistics furnished us by the operating companies.

"On the average each subscriber throughout the country now uses his telephone, upon calls made and received, 17 times per day.

"While this enlarged use is gratifying as an indication of the

enhanced value which the subscriber derives from the service, the greater demand thus made upon the exchange system of necessity involves a corresponding increase in the cost of rendering service, and a large investment per station for central office apparatus and trunk lines.

"Comparing the latest statistics with those of six years ago, we find the total number of subscribers has increased by 42 percent.

"Within the same time the average daily use of the exchange service by each subscriber has increased 40 per cent., and the number of employees engaged upon exchange work 76 per cent."

The new plan of measured service, already in operation in Boston, New York and Brooklyn, is referred to, and Mr. Hudson says that this system as an alternative to that of unlimited use, is equitable to those whose requirements for service are not large, and has commended itself to a considerable number of the telephone users in the exchanges named, some thousands being now connected on the measured service plan.

* * * * *

The question involved in Edison's application for patent for the carbon telephone has recently been determined by the supreme court in the case of Bate Refrigerator Co. vs. Ferdinand Sulzberger et al., which holds in substance that the domestic patent in such case is determined by the expiration of the foreign patent, notwithstanding that the domestic application is earlier than the application for the foreign patent. The result of the decision is to annul the Edison patent.

The Long Distance Company had invested up to Dec. 31, 1894, in line construction, equipment, and supplies, $7,460,662.97. The company shows an increase in gross earnings in 1894 over 1893 of 13.4 percent, the amount for 1894, gross, being $1,011,961.82. It will be remembered that the gross earnings for 1892 were $643,436.77; for 1893, $892,361.62."

The report shows a decrease in earnings of $932,832, a decrease in expenses of $131,131, and a total net decrease of $801,700.

The number of directors was increased from 12 to 13. Two new men were elected to the board, viz.: Charles W. Amory, who succeeds Thomas P. Bailey, resigned, and Moses Williams. William R. Driver was reelected treasurer and Charles Eustis Hubbard, clerk.

The list of directors as it now stands is: Charles W. Amory, Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, W. H. Forbes, H. S. Howe, C. E. Hubbard, John E. Hudson, Charles E. Perkins, Thomas Sanders and Moses Williams.

A LOWER TELEPHONE SCALE FOR NEW YORK CITY.

With regard to the editorial in THE ELECTRICAL ENGINEER last week on the local telephone tariff, we are now glad to be able to publish a further schedule of reduced rates, as follows. Any present subscriber to whom it offers advantages is at liberty to cancel his actual existing contract and take a new one under this new schedule:—

Messages.	Rate subject to rebate for unused messages.	Rate not subject to rebate for unused messages.	Extra Messages, Each.
1000	$120		8c.
1100	126		8
1200	132		8
1300	138		8
1400	144		8
1500	150	$145	7
1600	155		7
1700	160		7
1800	165		7
1900	170		7
2000	175	165	7
2100	180		7
2200	185		7
2300	190		7
2400	195		7
2500	200	180	7
2600	205		7
2700	210		7
2800	215		7
2900	220		7
3000	225	195	7
3100	230		7
3200	235		7
3300	240		7
3400	245		7
3500	250	210	7
3600	255		7
3700	260		7
3800	265		7
3900	270		7
4000	275	225	7

There is also an annual advance payment feature as follows:— For payment in advance of full price of contract an additional credit in messages equal to 10% of the number paid for will be allowed.

TELEPHONE NOTES.

MONROE, LA.—W. B. Reily is forming a telephone company.

SHREVEPORT, LA.—The Citizens' Co-operative Telephone Association has been organized.

LIBERTY, MISS.—A telephone line has just been established from Gloster to Liberty and is now in complete working order.

PARAGOULD, ARK.—E. S. Bray, T. B. Kitchens and Fred Hoffman have organized a company to operate a telephone exchange.

ELKIN, N. C.—A local company has been formed to establish a telephone exchange.

HARRIMAN, TENN.—A co-operative telephone company is being organized, and charter will be applied for. Address E. C. Drowne.

OCONTO, MICH.—W. L. Porter, of Ontonagon has been granted a franchise for ten years to operate a telephone system in Oconto.

BELL TELEPHONE RATES are being reduced about 25 per cent. in several Middle and Western States.

CINCINNATI, O.—The Bell Telephone Company is preparing to spend $160,000 for underground conduits in Cincinnati the coming summer.

DALTON, GA.—The Dalton Telephone Co. has been organized with Sam P. Maddox, president, C. D. McCutchen, Jr., secretary and general manager; J. C. Bivings, treasurer. A system will be established at once.

TAYLOR, TEX.—The Southwestern Telephone and Telegraph Company has begun work for the erection of poles in Taylor. Other work for putting in the telephone plant will be pushed along as rapidly as expedient.

CANTON, O.—The Harrison Telephone Company has been granted a franchise at Canton, that is not prohibitory, and it will begin the erection of a system at once. It is bound to rates one-half less than now paid the Bell Company.

MILWAUKEE, WIS.—A telephone line has been put in from the pumping station to the end of the intake tunnel constructed from the shore. This is about 2,000 feet. There is a possibility that a submarine cable will also connect the crib with this line before long. The line was ordered by the city.

PARSONS, KAS.—The Kansas Telephone and Electrical company of Parsons has been chartered. The capital is $40,000 and the directors are: A. B. Kerlin of Freeport, Ill.; D. L. Stewart, Shelbina, Mo.; C. W. Kegan, Wm. Busby and J. F. Steele of Parsons.

PETERSBURG, VA.—A new telephone company has been organized with the following officers: President, W. B. McIlwaine; vice-president, E. B. Hartley; secretary and treasurer, R. D. Gilliam. This company proposes to place telephones in business offices at $24 per annum and in private residences for $18.

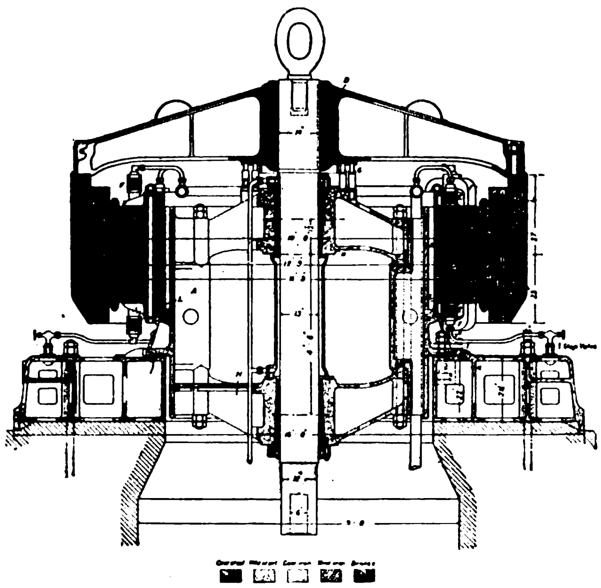
SALINEVILLE, O.—A company of Akron capitalists represented by L. K. Mihills, is anxious to place an exchange here, and offers to give connection with East Liverpool, Wellsville, Lisbon and other towns of the county within a short time after opening the exchange for subscribers at this place.

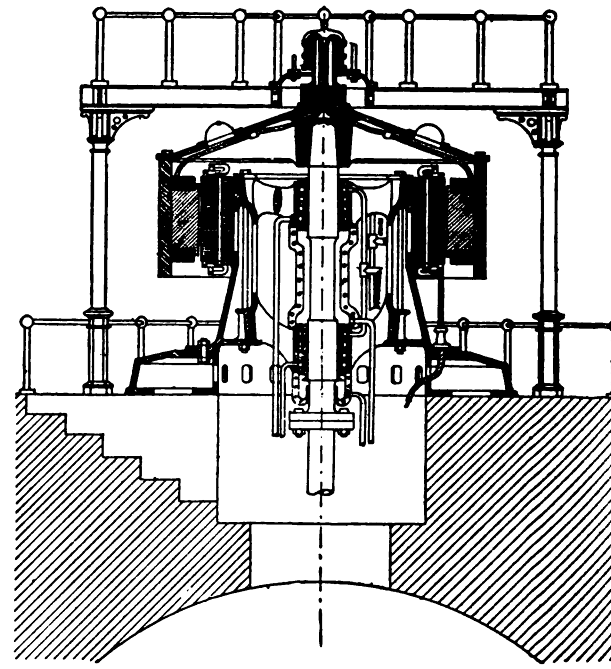
SOMERVILLE, N. J.—At the annual meeting of the Somerville and Raritan Telephone Company held recently the following officers were elected: George H. Cramer, President, and D. N. Messler, Secretary and Treasurer. The following were elected as Board of Managers: D. N. Messler, J. P. Hecht and Charles Schwed.

KEENE, N. H.—The New England Telephone & Telegraph Company will rebuild the line from Keene, N. H., to St. Johnsbury, Vt., with copper metallic circuits, and also that from Rutland to Burlington. The lines from Portland, Me., into the White Mountain section will also be rebuilt and improved and a line will be constructed from Cherryfield to Machias, Me.

FT. WAYNE, IND.—The officers of Ft. Wayne Harrison Telephone company have decided to commence construction immediately. The Harrison company starts with 700 subscribers. The prices are one-half the rate charged by the Bell company. The Harrison company have 160 plants in active operation throughout the country.

MIDDLEBURGH, N. Y.—The Middleburgh and Oak Hill Telephone Company has been incorporated with a capital stock of $500, to operate a line of telephone from Middleburgh to Franklinton, to Livingstonville, to Hawerville, to Preston Hollow, to Oak Hill, to Durham, these places being in the counties of Schoharie, Albany and Greene. The directors are Elias W. Dutton, A. B. Brayman and W. J. Chase of Livingstonville; William Earles, George Graham and Absalom Graham, of Franklinton; A. S. Coons, George F. White and George M. Hallenbeck, of Preston Hollow; Emerson Ford of Oak Hill and Willington E. Bassler.





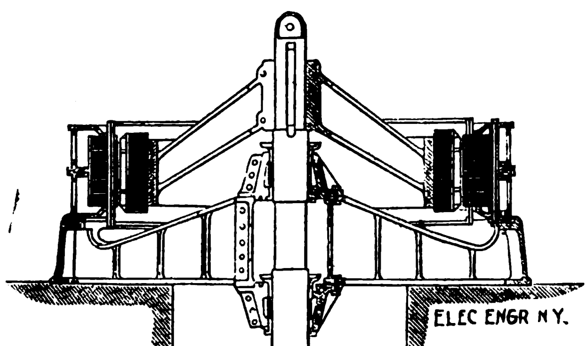
FORBES DESIGN. DESIGNS FOR THE TWO-PHASE GENERATORS AT NIAGARA. DESIGN ADOPTED.

THE NIAGARA DYNAMO CONTROVERSY.

THE controversy as to the authorship of the design adopted for the 5,000 H. P. alternators now being installed at Niagara has broken out afresh. In our issue of Sept. 26, 1894 we illustrated the machine actually constructed and that originally specified by Prof. Forbes for this work. In the London *Electrical Review* of March 15, Mr. C. E. L. Brown, of Baden, Switzerland, publishes the design submitted by him to the Niagara Construction Corporation on Sept. 20, 1892 which we reproduce below, in connection with the design of Prof. Forbes and that actually adopted, for the purpose of comparison. Mr. Brown bases his claims for priority on the following:—

"1. A design in which the employment of a vertical generator shaft, which is a prolongation of the turbine shaft, is rendered practicable.

"2. The 'umbrella shape' form of the field magnet system. This design obviates the necessity for a bearing above the field magnets, by bringing down the poles with their exciting coils



BROWN'S DESIGN FOR NIAGARA 5,000 H. P. ALTERNATOR.

into the same horizontal plane, with a bearing placed just above the floor line.

"3. The mode of winding the field coils with flat copper strip edge-on, so that the insulation cannot be crushed or otherwise damaged by the excessive centrifugal forces which, in this instance, will be exerted on the winding.

"4. The method of armature winding. In the scheme submitted I proposed that rectangular copper bars should be buried in slots in the armature, two in each slot; that the insulation should be mica; that the whole winding, including the end projections and connections, should lie on a cylindric surface. This latter arrangement facilitates removal in case of repair, reduces the number of bends, and likewise the number of joints to be soldered or otherwise connected, thus rendering more perfect insulation possible.

"In addition to the above, there are several minor points which it is not necessary to discuss here.

"It is quite true that Prof. Forbes has seen no machine of mine with an exterior rotating field magnet system, but I may in passing mention that, while developing the scheme I submitted, I had this arrangement in view (although I, at that time, in no way considered it a novel feature of design; for example, the same device will be found described and illustrated as employed by Patin in *L'Industrie Electrique* for May 25th, 1892), but its adoption for the case in question seemed to me unwise, for reasons already pointed out in the discussion of Forbes's paper, read before the Institution of Electrical Engineers.

"A comparison of the illustrations in THE ELECTRICAL ENGINEER of New York, January 16th, 1895, with the drawing I publish here, will establish the fact that certainly the first two points for which I claim priority have been introduced into the design of the Niagara alternators. Regarding the third point, the description is not sufficiently minute to say definitely, and as for the fourth, that too is indefinite. Allow me to point out that Figs. 2 and 4 do not agree with each other. In Fig. 2, V-shaped connections are shown, while Fig. 4 leads one to suppose that my method of end connections has been adopted."

INADEQUATE POLICE TELEGRAPH SYSTEM IN NEW YORK

Police Commissioner Andrews has been making a personal inspection of his Department and has found it wanting in certain respects. The police telegraph system he found especially in need of attention and expressed himself strongly in regard to it.

"The police telegraph is complete so far as it goes," he said. "There is not enough of it, however. It only practically consists of telegraphic and telephonic communication with the various station houses. This department should have a perfect police telegraph system, which should be so devised that communication can be had between the station houses and Headquarters, and every policeman on post. There should be a box on every man's post, so that he could send for assistance, call an ambulance or make reports, without leaving the post and travelling to the station house. In cases of trouble or disturbance of any kind such a system would be of great advantage. As it is now, policemen have to abandon their posts at times for various reasons.

"With a perfect telegraphic system every man would be kept constantly on his post. He could communicate with his precinct whenever the occasion required it. With such a system there could be a saving of several hundred men. It would be better to discontinue the appointing of 100 additional men yearly, for a period of several years, and establish such a telegraphic system as I have described. This department certainly requires it."

NANTASKET BEACH TROLLEY RAILWAY.

The work of grading for the foundation of the new power house of the Nantasket Beach old steam railroad has commenced and frogs and switches have been put in for the spur track to accommodate the construction trains. All of the piles for the first bridge have been driven, and the capping finished. The work of driving piles for the second bridge is progressing favorably.

LETTERS TO THE EDITOR.

MR. LOGAN'S CURIOUS LIGHT EFFECT

IN a letter to the editor, in your March 6 issue Mr. Logan describes a curious effect of light on asbestos, for which a solution is asked.

Possibly if Mr. Logan will try an experiment based on conditions in which he will not see the flash when it occurs, and then looks immediately at the asbestos, he may not see the "white, almost uncanny" light. The retention of light effect, or light impression, is the basis of the kaleidescope, the kinetograph, the thaumatrope, etc. Where the light is colored and the intensity high, the color impression is usually of the complementary hue. Mr. Logan can get considerable amusement out of high lights and colored glasses. Let him look simultaneously through a red glass with one eye and a blue one with the other, and he will get a fine purple. Red and green will produce a pretty brown, yellow and blue, a green, etc.

H.

CONVERTS TO THE STANLEY-KELLY ALTERNATING SYSTEM.

I have only just become aware of Mr. Dobrowolsky's interesting paper on the new alternators of the Allgemeine Elektricitäts Gesellschaft. Alternators of the type described have been built by the Stanley Electric Manufacturing Co. under patents granted to Mr. Stanley and myself, for a couple of years. The joint capacity of the generators now in service amounts to 7,500 kilowatts. I am glad to find our choice of a type confirmed by such a distinguished engineer as Mr. Dobrowolsky.

Even more interesting to me than the description of the alternators is the passage of the paper in which Mr. Dobrowolsky points out the magnitude of the lagging component of the current in induction motors, and its deleterious effect on the regulation of the generator. We have been calling attention to this for a long period, but we have been as one crying in the wilderness. The accession of such a recruit as Mr. Dobrowolsky is a great pleasure. The method of controlling the ill effects of lagging currents advocated by Mr. Dobrowolsky, the reduction of armature reaction to a minimum, is one as to which we are in hearty accord with him, and we have always insisted upon it. The only fault I would find with the method is that, while good, it is not sufficient. I hope yet to find Mr. Dobrowolsky an ardent advocate of the use of condensers.

I see by a later issue of the *Elektrotechnische Zeitschrift* that I must also extend congratulations to Mr. Arnold, of Oerlikon, as a convert to the induction alternator. JOHN F. KELLY.

PITTSFIELD, MASS., March 28, 1895.

OUT OF THINGS EVIL—GOOD.

Much has been written of the so-called iniquitous law limiting the life of an American patent to that of the foreign patent granted prior to it and having the shortest term to run. This law does seem to be without reason, and nobody knows the cause of its origination. But, we all must recognize that it has served a good purpose. It has served to circumvent several iniquitous combinations, and we ought to thank its originators for "building better than they knew," while at the same time we should relegate it to the tomb of the patents it has decapitated, since it has served its purpose.

All of the inventions which have been given to the public by this law have been amply protected and the owners of the patents have realized large returns from them, so they have no reason to complain. They have all had more than seventeen years of monopoly.

Our forefathers in framing the Constitution of the United States anticipated contingencies that were unthought of at the time, and they did it because of the destiny that shapes our ends; so also destiny impelled the law making powers to make this law, which even if iniquitous in itself has proven a blessing. We are eating the fruit; let us thank the planters of the tree.

STANLEY S. STOUT.

CHICAGO, March 22, 1895.

COST OF CENTRAL STATION STORAGE BATTERIES.

It is with considerable temerity that I offer again to the public my views upon any subject after reading in your last issue the authoritative opinion of Mr. Herbert Lloyd that Mr. Perry is not a man of ordinary intelligence, and that his statements are not only ridiculous, but *false*.

Mr. Lloyd clinches his argument by stating that I cannot distinguish the difference between a horse power and a horse power hour. This leaves me without a leg to stand on, but while admitting my weakness, and that I am no match for Mr. Lloyd in gentlemanly controversy, acknowledging a complete knock-out, I still beg to restate my position.

In the preparation of my paper read at the Cleveland Convention of the N. E. L. A., all available information was gathered as to the original cost and expense of maintenance of central station storage battery plants both here and abroad. Most of my conclusions were based on figures given by the Electric Storage Battery Co. of Philadelphia, of which Mr. Lloyd is the general manager. I believed them to be essentially correct.

Among other things Mr. Lloyd charges that my figures of original cost were too high, and that his company are willing to take contracts at much lower rates. If Mr. Lloyd will now publish this revised price list, with discounts for plants of various capacities, and with the specific guarantees which his Company will make for each, I should regard such statement as authentic and gracefully acknowledge my error if his prices prove to be lower than those given by me. It is on record that the price on one plant sold by Mr. Lloyd's Company since the Cleveland meeting was *higher* than the price assumed by me.

Mr. Lloyd still clings to the idea that Mr. Edgar's statement in regard to the battery plant purchased by the Boston Edison Company refutes my views and substantiates his position; whereas Mr. Edgar's explanation was accepted by every intelligent central station man at the Cleveland meeting as *proving* that the only place for a battery plant in central station service is in taking the peak off the load line. This was and is my exact position.

NELSON W. PERRY.

NEW YORK, March 30, 1895.

TESLA EXPERIMENTS IN BERLIN.

THE latest addition to the repertoire of the Berlin "Urania," or scientific theatre, is a complete demonstration of the celebrated Tesla experiments with currents of high frequency and high potential. This lecture has been arranged by Prof. Spies and on a recent occasion he was assisted by no less a personage than Prince Henry, brother of the German Emperor. Prince Henry interposed his body between the high tension terminals, and held exhausted tubes glowing under the influence of the Tesla currents.

PRODUCTION AND EFFECT OF KATHODE RAYS.

AT a recent meeting of the Société Française de Physique, M. de Kowalski read a paper on the "Conditions Necessary for the Production of Kathode Rays." Starting from an experiment due to Goldstein, in which in a vacuum tube having a constriction at its middle, it is found that the kathode rays are formed not only at the negative electrode, but also at the constriction, the author has made several experiments, using tubes of different shapes. He finds that wherever the electric discharge is sufficiently dense, as near the electrodes or in a capillary tube joining the two parts of a vacuum tube, kathode rays are produced. These rays are propagated in straight lines, are deviated by a magnet, and produce a bright patch where they strike the glass. The author has also succeeded in obtaining kathode rays in a tube without electrodes. This tube had somewhat the shape of an elongated hour-glass, and was placed alongside a discharger, through which "Tesla currents" were passed. Under these circumstances kathode rays are produced at either end of the capillary tube forming the central part of the vacuum tube. M. de Kowalski concludes from his experiments (1): that the production of cathode rays is not connected with the disintegration of metallic electrodes in a rarefied gas; (2) that these rays are produced wherever the density of the discharge is sufficiently great; (3) that the direction of the rays is the same as that of the lines of flow of the current at the point where they are produced, and that they are propagated in the opposite direction to that in which positive electricity is supposed to flow.

At the same meeting at which the above paper was read, M. Curie described some experiments he had made to see whether light rays were deviated by a magnetic field in the same manner as kathode rays. He has obtained no deviation, although his apparatus permitted him to pass the light rays for a distance of 20 cm. in a field having an intensity of 14,000 units, the direction of propagation of the light being perpendicular to the lines of force of the magnetic field. The experiment was made in air, as well as in carbon bisulphide in which sulphur had been dissolved. The author, although he does not think the above experiments are conclusive proof that kathode rays are radiation of a different nature from that which constitutes light, yet thinks they tend to show that there is some difference. Furthermore, if the kathode rays are analogous to light rays, it is difficult to explain the absence of double refraction when a magnetic field acts on the kathode rays.

Writing on the "Effect of Kathode Rays upon some Salts," in *Wiedemann's Annalen*, E. Goldstein states that lithium chloride, when exposed to kathode rays, assumes a heliotrope or dark violet color, which it retains for some time in a sealed tube. Chlorides and other haloid salts of potassium and sodium show similar effects. The colors are very superficial, and disappear on heating, or by the action of moisture.

According to W. A. Herz, in the same journal, the potential in the positive unstratified glow discharge of a vacuum tube decreases as the current increases, and also as the diameter of the tube is increased; but it increases with the pressure, though not as rapidly.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Communications for the Editorial Department should reach it not later than Thursday. Copy for advertisements should be handed in not later than Friday.

VOL. XIX. NEW YORK, APRIL 3, 1895. No. 361.

CONTENTS.

THE MEANING OF TROLLEY COMPETITION.

THE "Consolidated" Railroad is now paralleled by existing and proposed trolley lines all the way from the New York line to Springfield, Mass., a distance of over 100 miles; while the continuing parallels with steam roads from Springfield to Boston are thick and numerous. One can understand, therefore, the anxiety of the Consolidated management, but further reason for alarm is found in the destruction of their local traffic. Vice President Hall gives the following figures officially of the loss in the last three months on account of the electric roads:—Between Norwalk and Rowayton the loss was 50 per cent. of the regular traffic, Bridgeport and Southport 80 per cent., New Haven and Woodmont 50 per cent., New Haven and West Haven 70 per cent., Wallingford and Meriden 30 per cent., New Haven and Yalesville 45 per cent., Meriden and Yalesville 90 per cent., Southington and Plantsville 100 per cent., Unionville and Hartford 40 per cent., and Waterbury and Naugatuck 95 per cent. Between Naugatuck and Waterbury the sale of fares had fallen off 7,000 tickets a month.

Meantime the road is busily getting ready for its own electric cars on two branches, with the equipment we have recently described; and the Pennsylvania is playing a good second, by equipping two or three of its branches, to which frequent reference has already been made in these columns. The Consolidated road is trying combination cars that can be converted into steam cars or run on steam tracks; while the Pennsylvania is understood to be adopting different sizes of independent cars, 40 feet in length like passenger coaches but lighter, save with the addition of motors underneath. One equipment comprises four 25 horse power motors; one set two 75 h. p. motors and one set one 75 h. p. motor. Such power is obviously sufficient to operate the car with one or two trailers, the scheme that is probably contemplated. Other plans are in mind, not only with the roads we have named but with some that have to face the same problems and are slower in coming to the conclusion that the best way to meet electricity is to adopt it.

The difference to the public in expenditure for railway fare is not small, for the trolley scores under the head of economy as well as of that of convenience. Economy should and does include the reduction of effort and fatigue in reaching cars and depots, but we refer more particularly to fares. On the Mount Holly and Burlington trolley branch of the Pennsylvania R. R. excursion tickets that cost 36 cents under the steam regime are to be sold for 20 cents. Where there is a competition, fare also comes down to the trolley level, if possible. For example, between Germantown and Philadelphia, it is stated, it will probably be 15 instead of 25 cents on the Reading, and the fare to Chestnut Hill will be cut in two, making it only 20 cents for the round trip.

During the past week, further important changes of motive power have been announced on the part of leading steam railroads. It is now said that the Pennsylvania proposes to put electricity if possible on its Louisville and New Albany section. But most interesting of all is the news that the New York Central is to adopt electricity for its Buffalo and Niagara Falls section, using power from the Niagara Company. This has been foolishly denied by one or two officials of the old school, who

think that their obstinate prejudice will count, but it is so obvious an improvement that the wonder is the change has not been made already, especially as the Vanderbilts are interested in the Niagara project and will be buying power from themselves. As a matter of fact, it is possible that the projected paralleling by a trolley line may have finally turned the scale, for it is certain that the trolley with its sweeter, cleaner travel free from smoke, dust and cinders, and with its frequent service, would soon have walked away with the business. Be that as it may, plans are now being actively pushed, and it is to be inferred from interviews reported with Mr. Chauncey Depew that the heaviest passenger coaches will be hauled electrically over the road between the Falls and Buffalo. Mr. D. H. McMillan, attorney for the corporation at Buffalo, says it is not yet settled whether an additional track will be built but that it is likely the track will be deflected in places at least so as to give virtually an individual line to the Falls for the trolley cars; while, he adds, it is probable that in some places an additional right of way may be necessary. Mr. McMillan regards it as safe to assume that the fare will be reduced. There is, indeed, no good reason why it should not be. Niagara power, even if sent at 500 to 800 volts, continuous current, is cheaper than coal power on locomotives, and the two phase system can be utilized to transmit to the far end for feeding in, being there handled by rotary transformers. As we go to press news reaches us of a further plan said to be also backed by New York Central capital, for buying up the water powers of the Black River, to be used in operating electrically the Vanderbilt roads in Northern New York.

THE PRACTICAL TESLA OSCILLATOR.

When that notable assemblage of electricians, from whose ranks death has already removed one of its most shining lights, went forth from the lecture delivered by Mr. Tesla at the International Electrical Congress, in Chicago, in 1893, it is not too much to say that many came away with but a vague understanding of what the lecturer had sought to bring to their attention. At that lecture Mr. Tesla was too much engrossed in the description and the operation of his electrical and mechanical oscillator, to bring out clearly and sharply all the possibilities of this type of machine. Even since that time Mr. Tesla has been so absorbed in its development that he has had little time to elaborate on the facts which he brought out on that occasion. The late destruction by fire of practically all of Mr. Tesla's models has, fortunately, not deprived the world of the record of his work.

Thanks to the art of photography, we are enabled to present to our readers the article appearing on another page. The study of the evolution of a concept or machine must always prove instructive, and in the present instance the development of Mr. Tesla's oscillator from its original form constitutes a most valuable record of the origin and growth of an idea, the embodiment of which, in the opinion of its author, will make possible much that has heretofore been relegated to the realm of conjecture. Looking first at the most immediate application of the Tesla oscillator from the point of the steam engineer, a machine which permits of the employment of steam pressures of 300 pounds, or over, per square inch, practically without packing at the joints and without lubrication, at once gives the oscillator an advantage over the present type of steam engine, which a century has failed to secure for any type of the latter. If to this be added the absolute isochronous character of the oscillator over the widest ranges of load, there is gained another advantage which the highest skill of the steam engine builder has yet failed to accomplish fully in the most modern rotary steam engine. It is this absolute regularity of motion which is also destined to play an important part in the utilization of the currents generated through the medium of the oscillator in the attainment of those effects which Mr. Tesla deems essential to the accomplishment of one great problem of modern times, light without heat. While the theories on this point put forward by Mr. Tesla as the result of his experimental work have been called into question in some quarters, he is still as firmly convinced as ever of the correctness of his views. It is not to be denied, of course, that vacuum glow lighting effects can be obtained by other means, but Mr. Tesla is firmly convinced, we believe, that for the economical production of light without heat high potentials and high frequencies are indispensable elements, and that to obtain the highest perfection in this class of apparatus, practically absolute regularity in the production of the primary electrical impulses, which cannot be obtained by the ordinary forms of machinery, is necessary; and this is now made possible. The accomplishment of these immediate results made possible with the oscillator, both as a steam engine and as an electric generator, will, of itself, stamp it as a device of the first order of importance; and we may well leave to the future the working out of the problems which lie beyond and which Mr. Tesla holds forth as tangible possibilities of not distant years.

BELL COMPANY'S ANNUAL REPORT.

Elsewhere in this issue we print the major part of the annual report of the directors of the American Bell Telephone Company, presented at the stockholders' meeting March 26. A noteworthy feature of the report is the showing of a decrease in gross earnings of $932,800, and in net earnings of $810,700 (expenses showing a reduction of $131,100) notwithstanding an increase of 16,015 in the number of instruments under rental and an increase of 29 in the number of exchanges, an increase of 6,183 in the number of exchange (subscribers) circuits, as compared with 1894. The diminished revenue is seen to be due to the lessened receipts of the Bell Company for rental of telephones. The report shows, under earnings:

Rental of Telephones, 1893	$3,513,711
" " 1894	2,502,992
Decrease	$1,010,719
The number of instruments under rental was, in 1893	566,491
The number of instruments under rental was, in 1894	583,506
The average rental accruing to the Bell Company was, therefore, on each transmitter and receiver, in 1893	$6.20
" " in 1894	4.29
A decrease of	1.91

As pointed out by The Electrical Engineer, March 13, the rental or royalty charges are but a small fraction of the rates to telephone subscribers—a point not often noticed in the discussion of telephone rates by the daily press. Those charges, however, doubtless bear a very considerable ratio to the net earnings of the licensee or operating companies.

MISCELLANEOUS.

THE LOMBARD WATER WHEEL GOVERNOR.

AS APPLIED TO THE POWER TRANSMISSION PLANT AT BALTIC, CONN., FOR THE PONEMAH MILLS AT TAFTVILLE AND THE NORWICH STREET RAILWAY.

The recent installation in the power house of the Baltic Power Co., at Baltic, Conn., of a Lombard water wheel governor, has solved a difficulty which was rapidly becoming almost insuperable. In our issue of May 2, 1894, we described this plant as it existed about a year ago, when the three-phase current generated at Baltic was carried about four and a half miles to Taftville where

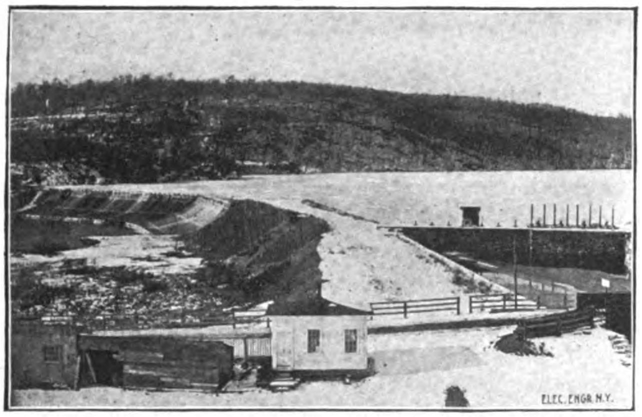


FIG. 2.—DAM OF BALTIC WATER POWER CO., BALTIC, CONN.

it was utilized solely for driving the machinery of part of the Ponemah Mills in that town. Since that time, however, Mr. E. P. Taft, the progressive founder of the Taftville cotton industry, has added the Norwich Street Railway and a 500 H. P. electric locomotive to the load of the Baltic Power Co., and the extreme fluctuations of the railway current made such a varying demand on the generators at Baltic, that the question of governing the turbines became of paramount importance. Every conceivable method was tried, but all without success, until the Lombard governor was installed a few weeks ago, since which time, the speed has been almost constant, no matter what the fluctuation of the load may be. It is not too much to say that this machine is practically perfect, and seems to almost anticipate any change of load. Probably the most severe test that this governor is put to is at noon and at six o'clock in the evening when the Ponemah Mills shut down, at which time about 400 H. P. is suddenly shut off, and the street railway circuits, with a maximum of about twenty to thirty cars, are left on. At these times the speed will increase only a revolution or two and in a very few seconds the governor has the work again in thorough control. Fig. 1 shows the governor at work, geared to an 800 H. P. P. C. Holmes horizontal turbine. This governor is manufactured by the Lombard Water Wheel Governor Co., of 61 Hampshire St., Boston.

Before describing the details of the Lombard governor, perhaps the best and the most graphic method of showing what it is capable of is by means of the diagram shown in Fig. 3 which represents readings of load and speed taken at frequent intervals when in actual service at the Baltic Power plant.

This diagram shows the load in horse power from 6.20 P. M. to 6.50 P. M. on March 6, 1895. The figures at the bottom of the diagram represent minutes, those at each end of the diagram represent load in horse-power; and the irregular line shows the variation of load each half minute. For convenience the load in horse power is indicated by figures where the load crosses the vertical lines,—that is at half minute intervals. The figures parallel with the load line show the variation in load each half minute. Thus, at 6.27 P. M. the load was 57 H. P.; one half minute later it was 273 H. P., showing an increase of load of 216 H. P. in half a minute; at 6.28 P. M. the load was 446 H. P., showing an increase of 173 H. P. in half a minute, or a variation in load in one minute of 216 +173=389 H. P.

By following the vertical lines to the top of the diagram the variations in speed may be seen. The dotted line shows the speed at which the wheels should have run and the full line shows the speed at which they did run. The figures above the speed line show the revolutions per minute of the tachometer shaft; and the figures below the speed line show the per cent. variation from normal speed.

Thus at 6.27 P. M. the speed was one per cent. higher than it should have been. One half minute later,—the load having increased 216 H. P. the wheel speed was just right; one half minute later (6.27½) the load now being 389 H. P. greater than one minute previous, the speed is one per cent. below what it should have been. The greatest variation may be seen at 6.31½ P. M. when the speed was two and one-tenth per cent. higher than it should have been.

An interesting example, showing how this governor will bring a wheel to normal speed under a wide but continuous variation of load, may be seen at 6.32½ P. M. Here the speed was two-tenths of one per cent. over normal speed. A heavy load begins to come on rapidly; the speed first falls five-tenths of one per cent. under speed and then rapidly comes back to where it should be, so that at 6.34 P. M. the speed is just right though the load has increased 397 H. P.

The diagram shown in Fig. 3 was purposely taken between 6.20 and 6.50 P. M., when the mills at Taftville were shut down

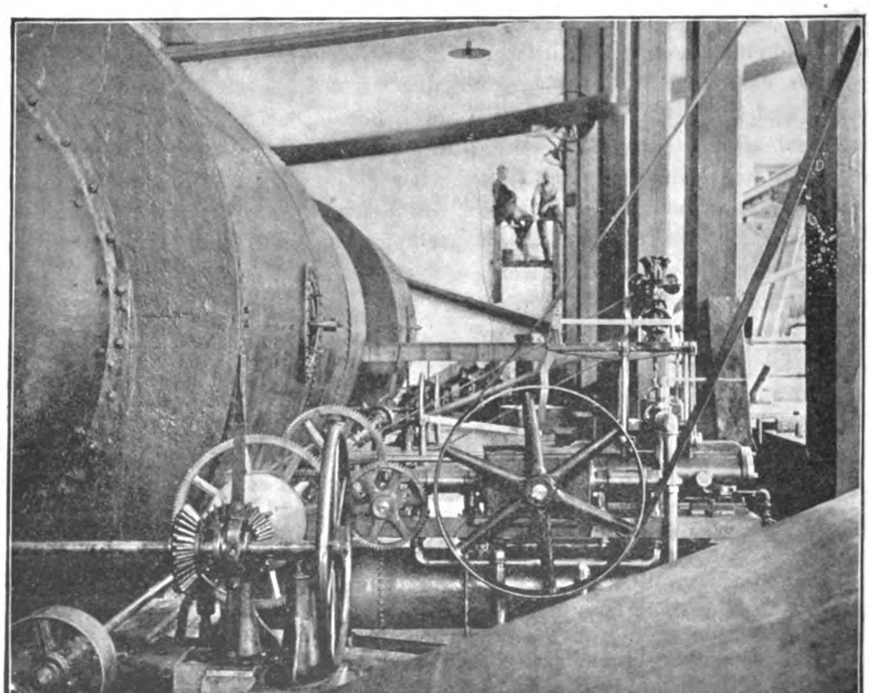


FIG. 1.—LOMBARD WATER WHEEL GOVERNOR IN POWER HOUSE OF BALTIC POWER CO., BALTIC, CONN.

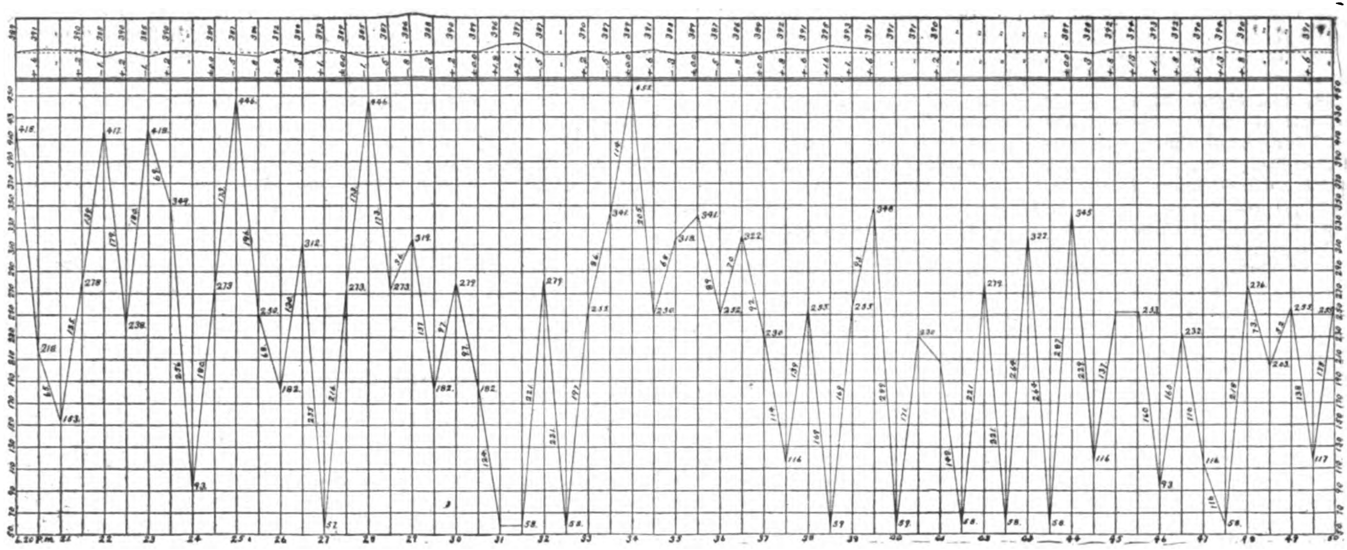


FIG. 3.—DIAGRAM OF LOAD AND SPEED TAKEN FROM THE PLANT OF THE BALTIC POWER CO., BALTIC, CONN.
NOTE.—The Figures Showing Per Cent. Variation are Decimal Parts of 1 Per Cent., not Whole Per Cent.

and the load consisted solely of the Norwich Electric Railway and the electric locomotive—the railway load alone being much more difficult to govern than the railroad and the mill combined. It should be added that one small incandescent machine is also driven from the jack shaft at Baltic, and no unpleasant variation in the lights is noticed.

After having thus seen what the Lombard water wheel governor will do, it will be interesting to know something of its construction, and the means by which it accomplishes its object.

The Lombard water-wheel governor consists essentially of an hydraulic piston which applies its thrust in either direction to the rack, pinion and gears, which gears transmit the motion of the piston to the gate mechanism of the turbine. The actuating force which operates the hydraulic piston is air compressed under about fifteen atmospheres (210 lbs. gauge pressure). This air is contained in the cylindrical tank under the bed plate of the governor and the pressure is maintained by a pump operated by the band wheel shown at the back of the machine in Fig. 1. The pressure tank is about one third full of a thin non-viscous oil and the piping is such that oil, and never air, enters the hydraulic cylinder. It will be noticed that about one-third of the distance from the left hand end of the pressure tank there is a row of rivet heads. At this point there is a tight partition across the tank and there is no connection between the right and left hand end of the tanks except by way of the piping and through the hydraulic cylinder. In the right hand end of the tank are oil and air under high pressure, and in the left hand end of the tank is a vacuum. The piping is such that the oil is discharged from the hydraulic cylinder into the vacuum tank and is immediately returned by the pump to the pressure tank. In this way a constant pressure and a constant vacuum are maintained. In other words, the oil circulates under pressure in a closed system without any access to atmospheric pressure. The circulating system is provided with a lever throttle valve and globe valves at various appropriate points; also pressure and vacuum gauges.

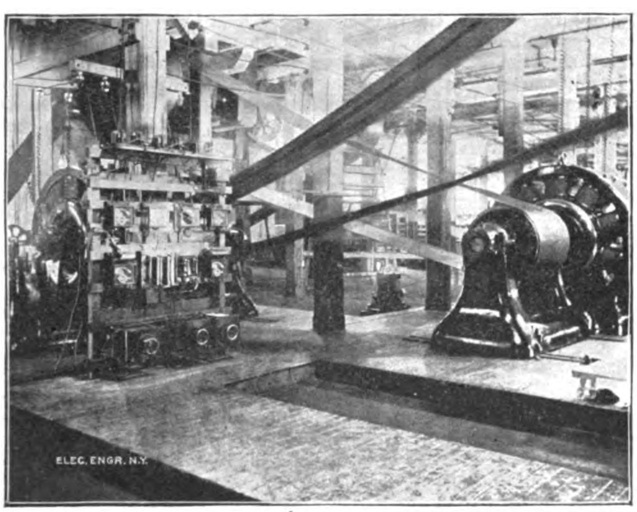


FIG. 4.—250 K. W. THREE-PHASE MOTORS, PONEMAH MILLS, TAFTVILLE, CONN.

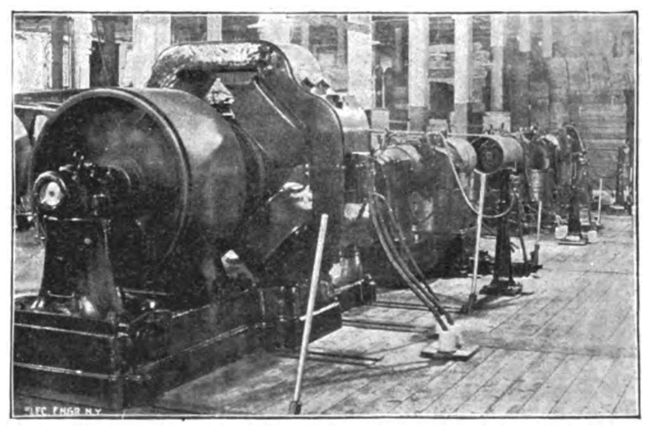


FIG. 5.—RAILWAY GENERATORS DRIVEN BY 3 PHASE ALTERNATING MOTORS.

The centrifugal governor balls actuate a perfectly balanced piston valve which stands in the circulating system. This valve has a lap of one sixty-fourth of an inch, and a motion of that amount one way or the other, as the speed varies, causes the hydraulic piston and train of gears to open or close the gates of the turbine. The mechanism of the valve motion is such that the full amount of motion due to the position of the balls is not used; in other words, the governor does not continue opening or closing the gates of the turbine until the centrifugal balls have resumed their normal position, but stops at such a position that when the various inertia forces have been absorbed, the turbine gates will be in the proper position for the new load.

This peculiar motion of the valve is positive, automatic and adjustable, and gives perfect control of the turbine no matter how great the variation of load. By this it is not meant that this governor will hold a wheel to an absolutely constant speed, but it gives a speed regulation that compares favorably with the best steam engine practice, and marks the beginning of a new era in the art of generating power by turbines.

Having described fully the method of controlling the speed at the Baltic power plant, a short description of the plant at Baltic and the driven plant at the Taftville end will be interesting, especially as considerable modification of the original plans have been made. The experience gained in running this three phase plant, one of the first important ones in the country, is exceedingly valuable to others either using or contemplating the use of this method of distribution.

The water power of the Baltic Power Co. is obtained by dam-

ming the Setucket River at Baltic, the dam, Fig. 2, being 31½ feet high and 500 feet wide, with an estimated available horse power of 1,600 average throughout the whole year. The wheels consist of two 800 H. P. and one 300 H. P. horizontal double turbines, manufactured by the P. C. Holmes Co., of Gardner, Me., and run at 150 revolutions per minute. The turbines are belted to a 7 inch steel shaft, supported on an iron frame work, resting on granite piers, and running at 300 revolutions per minute, the driven pulleys being on quills. The two generators, situated in the adjoining room, are driven from two quill pulleys fitted with Hunter friction clutches, and run at 600 revolutions per minute.

The generators, similar to the motors shown in Fig. 4, are the type of three-phase dynamos first turned out by the General Electric Co. They are 10-pole 2500 volt machines of 250 K. W. capacity, Fig. 4, and run of course at 50 cycles. The fields are excited by means of a 3 K. W. Edison bipolar, for each generator, driven from a 20 inch pulley on the collector end of the armature shaft. The field excitation for the generator running at 2500 volts is 20 amperes. This is much higher than in the more recent types and although it has its disadvantages, it is the opinion of the Company's electrical engineer that it is really preferable to the light excitation on account of the close regulation it forces. This especially holds good in the case of the generator that furnishes the current for the motor, at Taftville, that drives the street railway dynamos. The armatures are the standard Y-connected and the generated 2500 volts is across lines at the extremities of the legs.

The switch boards are of polished ash and contain ammeters for each line, of 80 amperes capacity, ammeters for the field, and voltmeters for exciting and main lines. The exciters are controlled by Carpenter enamel rheostats and the generator field by a special T. H. fire proof rheostat. The switches are all special high tension and non-arcing, on marble bases. There are two sets of lines to Taftville and the boards are so designed that the current can be controlled in every combination of parallel and separate running. The exciters are also so controlled that they can excite each generator or either can excite both machines.

The line is run to Taftville about 4½ miles on selected chestnut poles, 100 feet apart, and consists of three No. 1 B. & S. wires, and four No. 0000 cables. The wires are very thoroughly strung and are supported on heavy glass insulators on iron pins. The insulators are provided with oil cups, but owing to the summer dust it has been deemed better to run them dry. The line leakage is practically nil. In addition to the power wires there is a twin wire concentric cable suspended from a galvanized iron wire. This is very heavily insulated, and is used for telephone work and also for signaling. The signal bells are 10 inch single stroke gongs and are run on the 500 volt railway circuit from Taftville.

After reaching Ponemah Mills, Taftville, the wires are brought into a large basement to the motor switchboards. These are at present separate, and near each motor, one set of lines running to each; this arrangement is to be changed so as to combine boards, and make the combination of arrangements more complete.

The motors are of nearly the same type as the generators, and of the same size and K. W. capacity. The difference lies in the pole pieces. These in the motor are laminated, and are provided just beneath the face with a heavy copper winding, so arranged as to form, when closed, three closed coils one-third of a period apart. These of course, are only in use in starting the motors from rest. The original design was to close these coils and start the motors as induction motors with closed secondaries. This method gave a considerable maximum torque, but also a point that might be called a dead point, and at times required a slight start to the pulley. It also allowed the maximum starting current to flow at once. The Company's electrical engineer found by experimenting that the laminations in the pole pieces, interposed enough resistance to the secondary currents to cut down the starting current to about three-fifths the original, and yet allow enough to start the motor and bring it to about two-thirds speed without using the secondary winding. This, however, is closed when the motor has attained one-half to two-thirds speed, and it rapidly runs up to full speed when it is run as a synchronous motor by exciting the fields.

The ratio of motor field to generator field for the minimum line current is 21 to 20 on light loads. The current curve for different ratios being quite abrupt for light loads, a careful attention to the adjustment is necessary to obtain a minimum line current. Under heavy loads, however, the curve so nearly approaches a straight line that a considerable variation of field current can be made without affecting the input to any measurable degree. This is a very important factor when running lights on the same circuit with the motor and near the same end of the line, as the voltage may be varied at the motor so as to keep constant for the lights. This enables the motor attendant, at a mill for instance, to keep a constant voltage at the mill lights in case changes of load occur.

The motors at Taftville are used to replace two Harris-Corliss engines, single condensing. One motor is belted to a shaft from which 1,200 looms are run. These are mostly for "fancy" cloth, though a number are weaving plain. The other is belted to a shaft from which 500 looms are run. This shaft also belts to a line shaft driving one M. P. 200 K. W. 550 volt railway generator, and three D. 62 550 volt generators, Fig. 5. These are run in multiple, and furnish current from four slate panel boards to the Norwich Street Railway and the freight haulage system of the Ponemah Mills Co.

The Norwich Street Railway extends 26 miles and runs daily from 8 to 19 cars. The motor running this road and 500 looms is of about 350 H. P. and carries the load easily. It occasionally carries up to 500 H. P., and shows no sign of dropping out of phase.

The load on the street railway ranges from 0 to 400 H. P. and the speed variation at the railway generators is, at a maximum, 3.5 per cent., and averages but 2.3 per cent. under very sudden and heavy changes.

With regard to the economy of the system, the following figures show the results after nearly a year's running. The loss from generator pulleys to switch boards, at 700 H. P. output, is 6 per cent.; the line loss for 4½ miles at 2,500 volts, is 6 per cent.; the same to motor pulleys, making a full load loss of 18 per cent. At half that load the generator and motor loss is 10 per cent. each and the line from 3 to 4 per cent. These figures are extreme losses and are given for most unfavorable conditions for the efficiency. The adoption of this system saves in coal from $40 to $50 a day the year round, which, as can easily be seen, will pay a good interest on a considerable investment.

Aside from the power used of the plant, the "Nero mill," consisting of a two-story weave shop, is lighted with 1200 25 C. P. incandescent lamps. This not only does away with the cost of oil in producing gas for the same number of burners, but overcomes the soot, heat and flicker of gas flames. The light is greater and the chances of the goods being damaged thereby greatly lessened.

The Baltic station is in the basement of a large stone mill in the course of erection, and is a fine, light, roomy place. The room is lined with galvanized iron sheathing, and is painted white. At Ponemah Mills, however, the plant is installed in a basement about 14 feet high, that was used for storage and mill purposes. The mill shafting is hung from the ceiling in the most convenient place for driving from the engines. The motors and railway plant were installed some time later, and a great many problems had to be solved and good engineering done to so arrange the plant, as to obtain not only a high efficiency, but also to simplify the complicated arrangement, and still to fill all the necessary conditions. Mr. Taft, the treasurer of both companies, is a man of far reaching ability, and readily saw the value of skill in prosecuting such work and in engaging the services of competent engineers.

For many of the above details we are indebted to the kindness of Mr. H. E. Raymond, the electrical engineer of both the Baltic Power Co. and the station at Taftville, to whose energy much of the success of the plant is due, as many changes have been made involving careful study and a very thorough knowledge of the novel features of a three-phase system, the workings of which were little understood when the plant was first installed a year ago.

We are also indebted for our detail description of the working of the Lombard water wheel governor to Mr. Allan V. Garratt, chief engineer of the Lombard Water Wheel Governor Co., under whose careful supervision the governor was installed, and who took all the readings shown in our diagram, though the accuracy of the statements can readily be vouched for by the writer on a recent personal visit to the power house, where every claim made by Mr. Garratt was amply substantiated, by watching the governor at work for over an hour. A. C. S.

ELECTRICITY AND THE SHOE SHOP.

An interesting electric power transmission plant is in process of installation by the General Electric Company at Rochester, N. H., for the operation of Messrs. E. G. & E. Wallace's shoe factories. The system adopted is the three phase system, of the General Electric Company. The source of power is steam, the fuel being the scrap bark—the refuse from the tanneries. The generator will be a 140 kilowatt or about 190 H. P. machine wound for 560 volts, as the distance of transmission is insignificant. The motors will be of the induction type, without commutators or moving wires, and will be operated without the use of transformers. These motors will be 500 volt machines, of 5 H. P., 15 H. P., 20 H. P. and 25 H. P. capacities. Another generator to be used principally for lighting will shortly be added.

The installation of this plant was determined upon after a careful examination of the merits of the three-phase system, and the economy likely to be induced by its adoption, when compared to the cost of installation and maintenance of a system of mechanical distribution of power, i. e., by belts, line shafting etc. Messrs. E. G. & E. Wallace had already experimented with motors in the operation of their shoe factory, and the great economical and other benefits which accrued, proved the deciding factor which resulted in the present installation

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 26, 1895.

Alarms and Signals:—

Electrical Signaling Apparatus, W. E. M. Jackson, San Francisco, Cal., 536,210. Filed June 8, 1893.
Especially adapted for making a printed record of signals sent electrically from a number of stations to a common receiving instrument.
Electrical Signal and Switch Operating Apparatus, J. Dutrey, New Orleans, La., 536,271. Filed July 19, 1894.
Designed to effect communication between two or more locomotives traveling upon the same track.
Signal for Railway Crossings, E. A. Hermann, St. Louis, Mo., 536,499. Filed Oct. 1, 1894.
System of Electrical Signal for Railways, C. Selden, Baltimore, Md., 536,547. Filed Dec. 26, 1894.
The signal or local circuit is closed and the signal operated immediately upon the passage of the first pair of wheels of the locomotive or a train over the proper track circuit closing instrument.

Conductors, Conduits and Insulators:—

Method of Applying Insulation, F. E. Chase, Schenectady, N. Y., 536,184. Filed June 21, 1894.
The method of applying insulation which consists in applying when cold to the part to which it is to be united, an insulating compressed material adapted to expand under heat and retain its expanded form when cold, and then heating the insulation while the compressed material and the part to which it is to be united are held firmly together.
Flexible Tube, H. H. Brooks, Medford, Mass., 536,417. Filed Sept. 18, 1894.
The flexible metallic tube having an internal spiral reinforce, composed of a strip of paper material.

Distribution:—

Method of Insulating High Tension Coils of Transformers, A. Schneller, Aarlanderveen-Alfen & W. J. Wisse, Haarlem, Holland, 536,319. Filed Dec. 27, 1894.
The method consists in boiling the coils of insulated wire in wax, evaporating the moisture by putting the coils in use for a short time, and then filling the interstices with additional wax.

Dynamos and Motors:—

Armature for Electric Machines, E. C. Morgan, Chicago, Ill., 536,439. Filed July 18, 1894.
Claim 1:—An armature for an electric machine having its coils connected by an independent conducting plate and an insulating wedge through which the plate passes and by which it is braced. Intended particularly for mining machines.
Electric Current Regulator, C. M. Jordan, Washington, D. C., 536,580. Filed Feb. 13, 1895.
Provides motors, one driven by a circuit not subject to the fluctuations of the working circuit, and the other subject to the fluctuations of the working circuit, the two motors operating in opposition to each other for moving or controlling an electric current regulator within the working circuit.

Electrometallurgy:—

Magnetic Separator, J. D. McKinnon, Portland, Ore., 536,296. Filed Aug. 7, 1894.
In a magnetic separator, the combination with a plurality of magnetized cylinders, a metallic belt connecting the cylinders, a non-metallic belt arranged over the metallic belt, and an agitator for said belts.
Process of Producing Metal Art Objects Set with Jewels, V. G. Bloede, Catonsville, Md., 536,259. Filed Dec. 22, 1893.
Consists in effecting the fixation or setting of the jewels, stones or other material, by films or bezels of metal produced by electric deposition into or upon temporary plastic moulds, in which the stones or jewels have been previously inserted.

Measurement:—

Combination Electrical Meter, H. C. Parker, Brooklyn, N. Y., 536,478. Filed Jan. 9, 1895.
Consists essentially of a pair of coils wound, respectively, for low and high resistance, and arranged on a common axis to turn between the poles of a permanent magnet, the coils being arranged to move a hand or indicator over a table of gauge marks.

Railways and Apparatus:—

Closed Conduit Electric Railway, W. Lawrence, New York. Reissued 11,481. Filed Mch. 13, 1894.
Consists of a sectional conductor with automatic contact makers by means of which the current is shut off from the working conductor except when the car is passing.
Adjustable Switch for Trolley Systems, M. M. Wood, Chicago, Ill., 536,250. Filed July 14, 1894.
An overhead trolley switch having tongues adjustably attached to a plate and a clamping device for securing the tongues in position.
Supply System for Electric Railways, C. E. Emery, Brooklyn, N. Y., 536,275. Filed Mch. 15, 1894.
Communication between stationary electric conductors and a movable car is established by an electric conducting rope or chain which is dragged through fixed troughs on grooved rollers, some of which are energized with electric current.
Electric Railway Switch, R. A. Baldwin, So. Norwalk, Conn., 536,256. Filed Oct. 24, 1893.
Conduit Electric Railway, F. S. Davenport, Jerseyville, Ill, 536,374 Filed Jan. 28, 1895.
Employs a sectional conductor from which current is taken at intervals by a contact shoe.
Electric Brake, E. D. Lewis, Savona, N. Y., 536,536. Filed Nov. 12, 1894.
Two electro magnets are provided as a means for applying the brakes in connection with an electro-motive force derived from a suitable source.

Miscellaneous:—

Electric Mining Machine, E. C. Morgan, Chicago, Ill., 536 438. Filed July 18, 1894.
The combination with a cam having its active driving surface extended from the axial line of the shaft to a point on its periphery and a bracing flange projecting therefrom, and extending partly over and beyond the active surface of such cam and affording the connecting base for the shaft, of a plunger having a roller adapted to be engaged by the cam and to pass under the bracing flange in its travel.

Switches, Cut-Outs, etc.:—

Electric Switch, C. J. Miller, Philadelphia, Pa., 536,321. Filed Jan. 19, 1895.
A knife switch so constructed as to have an instantaneous release from the contact plates.
Electric Switch, C. C. Chesney, Pittsfield, Mass., 537,266. Filed Jan. 17, 1895.
Employs a casing enclosing the jaw of the switch and having a slide controlled by the lever bar controlling the contact blade.
Fusible Cut-Out, J. J. Wood, Fort Wayne, Ind., 536,311. Filed Dec. 27, 1894.
Provides improvements in double pole fuse boxes designed to make it impossible for the blowing of one fuse to arc across to the other side of the line.

Telegraphs:—

Telegraphy, P. B. Delany, South Orange, N. J., 536,490. Filed Nov. 19, 1894.
The invention comprises an automatic transmitting device worked in connection with the polarized neutral instrument to establish contact through the perforations of a transmitting tape.
Relay, C. R. J. Willot, Paris, France, 536,559. Filed Nov. 24, 1893.
The two armatures are suspended and connected on the same axis and are acted upon by a magnetic field consisting of a polarized magnet and two breach pieces of soft iron placed at the extremities of the electro magnet.

Telephones:—

Telephone System, J. I. Sabin & W. Hampton, San Francisco, Cal., 536,233, Filed Nov. 9, 1894.
A switchboard in which the wires extend in groups to separate sections of the board, and having a local trunk line plug provided at one of the sections and adapted to be inserted in the switch of the called subscriber; a switch at each section connected in circuit with the local trunk line plug, and means for connecting the line at any one of the sections with the switch to complete the circuit.
Telephone Exchange System, S. W. Holman, Boston, Mass., 536,382. Filed March 24, 1894.
Employs a switchboard commutator consisting of a transmitting and receiving telephone attached to the person and having each terminal connected to metallic thimbles placed upon the fingers of one or both hands.
Electric Signal System, W. Gillette, New York & A. S. Williams, Long Island City, N. Y., 536,467. Filed Oct. 30, 1894.
Employs a telephone support with switch contacts for completing the local and line circuits.
Telephone, J. D. Price, Chicago, Ill., 536,481. Filed July 30, 1894.
The invention consists in having the transmitter box hinged to the back board by pillow blocks.

LEGAL NOTES.

THE COSMOPOLITAN ELECTRIC CO., of Chicago, has had its extraordinarily broad franchise held of doubtful value by Judge Payne. His decision on a motion for an injunction is that the ordinance passed by the common council granting the franchise was illegally passed and therefore invalid and inoperative.

THE LAMP INJUNCTIONS obtained by the New York Edison Electric Company against the United Electric Light and Power Company, the Sawyer-Man, and the Mt. Morris Electric Light Company, and a number of individuals, have been dissolved by Judge Lacombe, as the patent is now null and void under which they were obtained.

THE N. Y. COURT OF APPEALS ON THE RESPONSIBILITY OF MOTORMEN.

The N. Y. Court of Appeals has reversed the decision of the city court in Brooklyn in the case of Richard Keenan, administrator, against the City Railroad company, in which the plaintiff originally recovered judgment for $5,550. The suit was for damages for the death of James Keenan, aged 5 years, who was run over and killed by a Third avenue trolley car on May 12, 1893.

The court declared that, if in a case of a sudden emergency, such as was presented in that case, the driver did all in his power to stop his car after the child was in actual peril upon the track, he did all that the law required of him.

TROLLEY RIGHT OF EMINENT DOMAIN IN PENNSYLVANIA.

Justice Williams, of the Supreme Court of Pennsylvania, has handed down an important decision in which he sets aside the claim of eminent domain on country roads, made by trolley companies in that State. The companies both in Pennsylvania and in Jersey are studying out the possible applications of the ruling.

LOCAL EDISON COMPANIES AND INSTALLATION WORK.

The subjoined notice, pointing to a new deal between the General Electric Co. and its Edison licensees, has been issued by the Edison Electric Ill. Co. of New York, signed by C. S. Shepard, controller:—

Please note that after March 31, 1895, all Edison apparatus, supplies and lamps, should be ordered from and will be furnished directly by the General Electric Company, the manufacturers of all Edison supplies. From that date also this company will have no interest in or special relation with any installation contractors, and it is specifically provided in our arrangement with the General Company that it shall not directly or indirectly engage in installation work in this territory, but that contractors shall have here an absolutely free field. This arrangement has been made in the belief that it will meet the desires and further the interests of installation contractors.

THE LILLIE WIRE JOINT.

Next to high conductivity in the conductor itself, the value of a line depends upon the character of the joints and much ingen uity has been expended in the past in the devising of means for securing good joints. The latest attempt in this direction which has come under our notice is that of Mr. N. W. Lillie, of Somerville, Mass., whose joint is illustrated in the accompanying engravings, which are so clear as to require scarcely any further description.

The wires to be joined are simply laid in the channels of an S-shaped strip of copper Fig. 1, and then twisted until they assume

Figs. 1 and 2.—The Lillie Wire Joint.

the shape shown in Fig. 2. According to the inventor, the walls of the connector are by this means drawn tightly into contact with the wires, while the overlapping edges of each channel press firmly against the outer surface of the other channel, forming a tight joint which thoroughly excludes moisture.

THE RATING OF FEED WATER HEATERS.

The Feed Water Heater Manufacturers Association, Frank A. Thayer, Secretary, of 14 Church Street, New York, have issued the following :—

We certain manufacturers of closed feed water heaters, in convention assembled declaring

That a better understanding among ourselves and also between each of us and our customers in the matter of rating of feed water heaters, is much to be desired, do hereby *Resolve*

That we believe that the only proper rating for feed water heaters is one which is based upon the square feet of heating surface contained in the heater. For the purpose of giving practical shape to this belief we do further *Resolve*

That we hereby agree that for the future we will in each and every case in which we are called upon to make prices upon heaters, state the exact number of square feet of surface which we are offering; to give further effect to this action we *Resolve*

That we will in each and every case, state without reservation both in our printed catalogues and in our specifications, the diameter of the tubes, the number of lineal feet thereof and the total square feet of heating surface in each heater offered.

Resolved further, that the Secretary be requested to transmit a copy of these Resolutions to every manufacturer of closed heaters in the United States.

And we hereby agree to live up to the spirit and the letter of the foregoing and to bind ourselves so to do by our signatures affixed below.

Resolved finally that the Secretary be requested to invite all closed heater manufacturers of the United States to join this Association and to subscribe to the foregoing resolutions.

Signed, The Taunton Locomotive Mfg. Co. (Makers of the Wainwright Feed Water Heater); Benj. F. Kelley & Son (Makers of the Berryman Feed Water Heater); Wm. Baragwanath & Son (Makers of the Baragwanath Feed Water Heater); The Goubert Mfg. Co. (Makers of the Goubert Feed Water Heater); The National Pipe Bending Co. (Makers of the National Feed Water Heater); Robt. Wetherill & Co. (Makers of the Wetherill Feed Water Heater); Keystone Engine & Machine Works (Makers of the Keystone Feed Water Heater.)

A LARGE POWER ENTERPRISE IN MEXICO.

A most interesting and important electric power installation is now under construction for the Cia. Anonima de Transmission Electrica de Potencia, located in the State of Hidalgo, some 100 miles north of the City of Mexico. The water is taken from the Arroyo de Regla, a mountain stream having a minimum supply of 1,500 cubic feet per minute. A natural rock dam at a point in the canyon, impounds the water sufficiently to admit of its being diverted by a cut through the bluff into a canal which follows mostly the contour of the mountain—a distance of 1½ miles. This involved the cutting of seven tunnels aggregating a total length of 1,200 feet through solid rock. From the terminus of the Canal, the water is carried to the power station through 1,700 ft. of 30 in. pipe, which affords a vertical head of 800 feet, this being of varying thickness to correspond to the pressure at various points on the line, the lowest portion being made of steel ¾ of an inch thick. The pipe line discharges into a receiver 40 in. diameter by 75 ft. long, with which the wheels are connected by lateral branches. This is made of flange steel plates ¼ in. thick, tested to 700 lbs. water pressure, and weighs upwards of 50,000 lbs.

The power station consists of five Pelton wheels 40 in. diameter, of capacity of 400 H. P. each—direct connected to the same number of 12 pole, three-phase generators running at a speed of 600 revs. delivering the current at a pressure of 700 volts; also two 24 in. Pelton wheels speeded at 1,700 revs. for running the exciters. The step-up transformers are wound for a ratio of 1 to 15, making the line potential a little over 10,000 volts at the generator end. There are three transformer sub-stations in which air blast transformers are to be used. Pelton differential governors are attached to each wheel for purpose of regulation.

This station is to supply power to the mines of the Rio del Monto Company—one of the most extensive mining organizations in the world, employing upwards of 8,000 men. The power is to be used for operating mining machinery such as stamp mills, crushers, pumps, hoists, ventilators, etc., etc. The mines of this Company—said to be the richest in Mexico—are located within a radius of 20 miles, the maximum distance of power transmission being 23 miles and the mean distance about 18 miles. Various other mines in the vicinity will also be supplied with power from this station and the City of Pachuca also furnished with light. A market for the entire power being thus afforded at highly remunerative rates, the financial success of the enterprise is assured—in fact it is claimed that the entire outlay—some three hundred thousand dollars,—will be returned to the Company in two years time, from the saving effected in fuel heretofore required in carrying on their various operations.

This important enterprise—involving many difficult engineering problems, originated with, and is being carried to completion under the direction of Senor R. M. de Arozarona, an accomplished engineer, resident of the city of Mexico, also a director of the Company. The Pelton Water Wheel Company, of San Francisco and New York, have the contract for the hydraulic part of the work, and the Thomson-Houston International Company of New York, for the installation of electrical machinery.

THE ELECTRICAL INDUSTRIES OF ST. LOUIS.[1]

BY WILLIAM H. BRYAN, M. E., E. E.

The arc lighting of St. Louis is done by four companies, who operate about 4,500 lights of a nominal capacity of 2,000 candles each. The incandescent lighting is done by three companies, which now have approximately 175,000 lights connected. The electrical equipment of these several stations aggregates 20,000 horse-power. The service extends over the entire city and as far west as Kirkwood. In common with other interests they have suffered somewhat from the business depression of 1894, and their growth, while it has by no means ceased, has not been as large proportionately as in former years. The year 1895 will see extensive enlargements made, both to the plants and distribution systems. The most important advancement to be expected in the immediate future is the placing of the major part of the wiring under ground, which consummation it is expected will be reached within the next twelvemonth.

St. Louis also ranks high in the distribution of electricity for power purposes. Three companies distribute an aggregate of about 4,000 horse-power throughout the city. Electricity has displaced steam in hundreds of small manufacturing establishments, and has recently come into quite extensive use for elevator service in our tall buildings, for which it seems to be admirably adapted.

It is in connection with street railways, however, that electricity has met its widest field of work in this city. Nine companies, capitalized at about $17,000,000, operate some 275 miles of single track, running 500 motor cars, with 20,000 horse-power of electrical equipment, and 600 trailers. There are eight power houses, with a total electrical equipment of about 23,000 horse-power. These lines carried 65,000,000 in 1894, a gain of about 8 per cent. over 1893. These roads have added to their equipment during the year 1894 steam and electrical apparatus of 8,500 horse-power, valued at $800,000 and have built during the year thirty-three miles of single track. The electric railway companies employ about 4,000 men regularly. Considerable extensions will be made during the coming year, and a number of suburban electric roads, connecting with existing down-town lines, will probably be built.

In electrical manufactures St. Louis ranks high. It has always been a centre of the carbon industry, and continues so at this day. The manufacture of incandescent lamps has also grown to be large and important. Recently the manufacture of alternating current motors, fans, and converters has been taken up, and is being actively pushed. The product of these factories has become widely known, and goes to all parts of the globe.

Five large supply houses furnish electrical material and equipment. The capital invested is in the neighborhood of $125,000, and they did a gross business of about $500,000 during 1894, being just about the same as was done in 1893. These companies carry a stock valued at about $125,000, and the territory covered includes the entire Southwest.

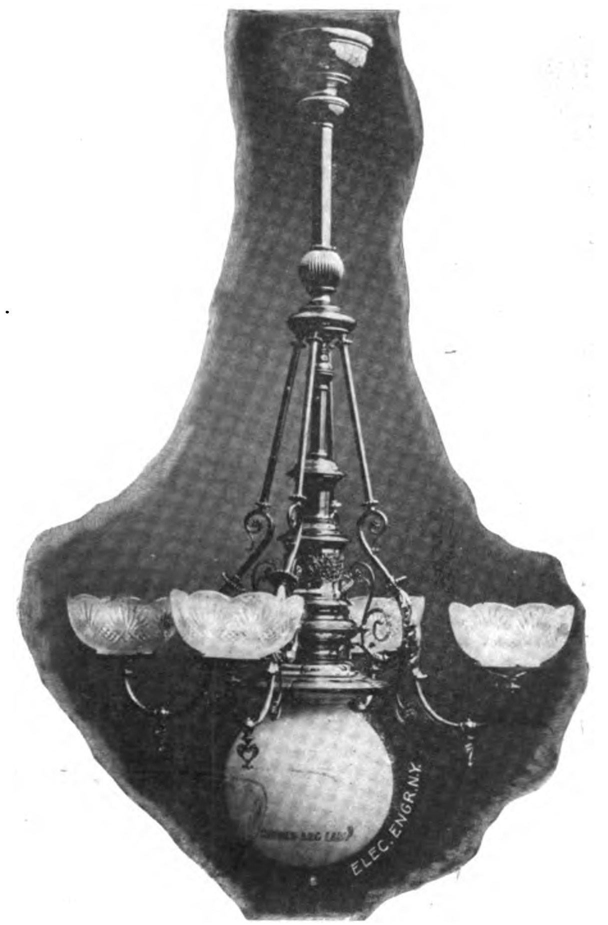
1. Extract from Annual Report of G.H. Morgan, Sec. Merchants' Exchange.

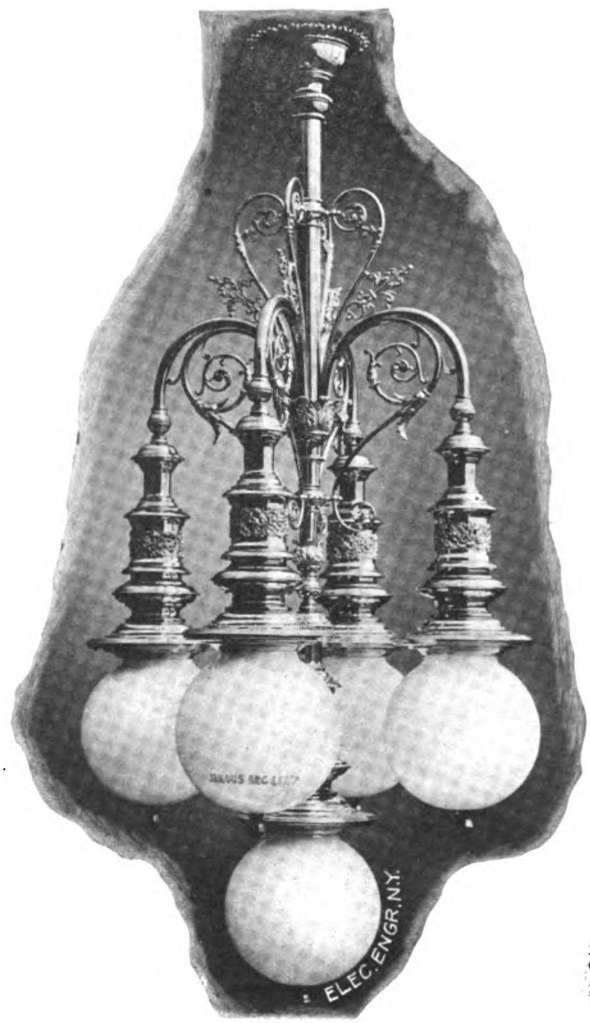
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

MR. F. A. LA ROCHE.

It will interest a wide circle of those engaged in electrical industries and pursuits to learn that Mr. F. A. La Roche, the well known electrical engineer and manufacturer of Philadelphia, has now become actively associated with work in New York City, while maintaining his connection with his older enterprises. He is now the vice president and general manager of the New York Electric Equipment Co., which has of late years done so large a share of the electrical installation work in this part of the world; and it is safe to predict that under his supervision things will not lag. The work of the Company, besides including that of the local Edison installations, embraces many important branches and details, and to all of these Mr. La Roche will give his personal attention. He is a welcome addition to the electrical ranks in New York, where he has a great many friends. The company is to be congratulated on securing Mr. La Roche's services, especially as it is understood that Mr. Bergmann has retired from active management, although he will remain president of the company.





FIGS. 1 AND 2.—COMBINATION OF JANDUS (MANHATTAN) ARC LAMP IN GROUPS AND WITH GAS JETS.

THE JANDUS ARC ELECTROLIERS.

ELECTROLIERS carrying incandescent lamps are now so familiar as to call for no special comment as a type, but an electrolier carrying a group of arc lamps was a novelty that called forth much admiration on the part of the attendants at the recent Electric Light Convention in Cleveland. These electroliers were exhibited by the Jandus Electric Co., of Cleveland, and our illustrations show two designs, Fig. 1 being intended as a combination gas and arc fixture and Fig. 2 as an arc electrolier pure and simple. The lamps were all of the constant potential type all run singly and were adjusted to take about 85 volts, the remaining 35 volts being taken up in resistance concealed in the ornamental part of the lamp. These lamps may be made to take from 11 to 3 amperes, consuming at the arc from 125 to 680 watts on a 110 volt circuit, or more, if desired, the same lamps being adjustable for large or small currents, the size of the globes alone being varied for high or low powers. These arc lamps readily adapt themselves to electrolier combinations with incandescents or gas, the same wiring answering for both, since both are connected directly across the circuit.

One of the most important features of these lamps is the eveness with which they diffuse the light over the whole globe, there being no defined bands of light and shade perceptible. The light is very steady and the carbons, being enclosed, consume at the slow rate of from 15 to 40 hours per inch, according to the watts consumed at the arc. The Jandus Electric Co., of Cleveland, are the sole agents for the United States for these lamps.

WALKER MANUFACTURING CO.

The Walker Manufacturing Co., Cleveland, Ohio, have closed the following conrtracts between March 1st and March 22d, 1895: Burhorn & Granger, No. 136 Liberty Street, New York City, 2 25 kilowatt direct coupled lighting generators. F. E. Snow, receiver, Adrian City Electric Belt R'y Co., Adrian, Mich., 1-60 kilowatt belted generator, 3 25 H. P. single equipments. Union Depot Railroad Co., St. Louis, Mo., 41 double car equipments, 82 30 H. P. steel motors. Pittsburgh Traction Co., Pittsburgh, Pa., 1 double car equipment, 2 30 H. P. steel motors. Pittsburgh, Crafton & Mansfield Passenger R'y Co., Pittsburgh, Pa., 1 double car equipment, 2 50 H. P. steel motors. Federal Street & Pleasant Valley Pass. R'y Co., Pittsburgh, Pa., 2 double car equipments, 4 30 H. P. steel motors. Suburban & Rapid Transit Street R'y Co., Pittsburgh, Pa., 1 double car equipment, 2 25 H. P. steel motors. Schuylkill Electric Railway Co., Pottsville, Pa., 4 double car equipments, 8 25 H. P. steel motors. Chicago City Railway Co., Chicago, Ill., 49 double car equipments, 98 25 H. P. steel motors.

A RECENT ruling of the Canadian Customs authorities puts a tax of 20 per cent on electrical current entering the country.

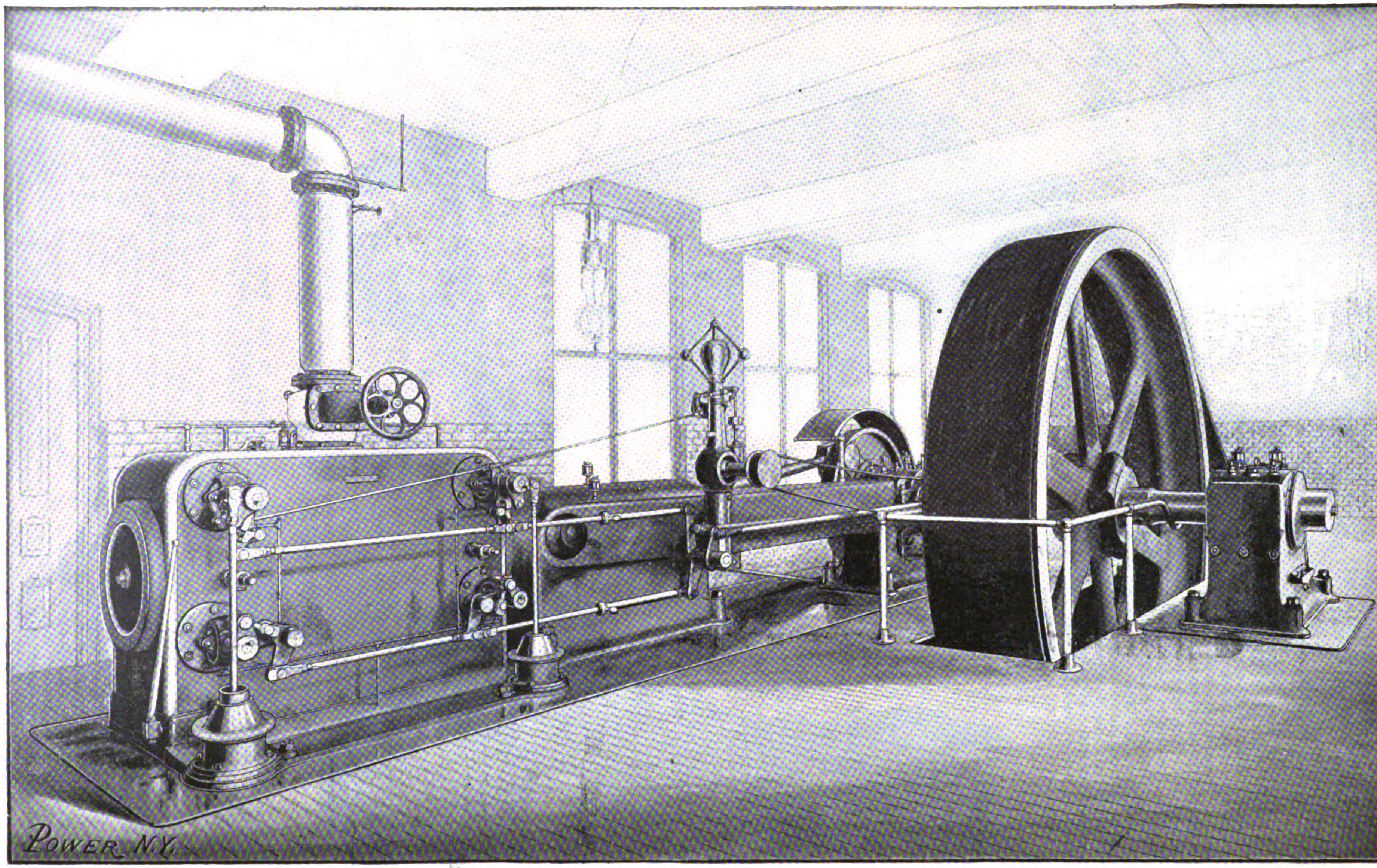


Fig. 1.—The Rice & Sargent Engine for Electric Lighting.

THE RICE AND SARGENT ENGINE FOR ELECTRIC LIGHTING.

We illustrate in the accompanying engravings the new, automatic, four-valve, releasing-gear engine, built by the Rice & Sargent Engine Company, of Providence, R. I. The engraving Fig. 1 shows a 20″ x 42″ engine recently built by this firm for the new shops of The Howard & Bullough American Machine Company, Limited, of Pawtucket, R. I.

The bed-plate is designed with box-sections, and the material is distributed to best resist strains. The guides are bored and end of bed-plate faced to fit cylinder at one setting of the boring-bar, and the guides are supported their entire length by a broad base, resting on the foundation and secured by four foundation-bolts. The pillow-block also has a broad base and four foundation-bolts. The out-board pillow-block in the engine here shown is made similar to the main pillow-block, and the shaft is extended through,—all being arranged for making a double engine or cross-compound later on, when increase of load requires it.

The pillow-block is full babbitted and fitted with four-part

boxes, with wedge adjustment for the side boxes, and also chain oiler for continuous lubrication. The disc crank with counterpoise is used; the hub of the crank next the pillow-block has a circular groove which delivers oil escaping from the pillow-block, to the crank-pin, which is also provided with a centrifugal oiler and stand.

The cylinder is provided with four, double-ported, Corliss valves, Fig. 2, and with steam and exhaust-chests,—the latter being separated from the barrel of the cylinder by an air-space, to prevent cylinder condensation. The exhaust-valves are brought well up into the cylinder so as to reduce the clearance, and at the same time the valves cannot interfere with the piston in any position. The cylinder is provided with adjustable spring relief-valves, and the front end is telescoped and bolted to the flange of the bed-plate. The back end of the cylinder slides in clamps on a foot with two foundation-bolts. The cylinder is covered with magnesia and lagged with heavy sheet steel.

The valve-gear is a new form of releasing-gear, having separate eccentrics for the steam and exhaust-valves. This enables a ready adjustment of the valves to suit any condition of running, and the cut-off of the steam is controlled by the governor from 0 to ¾ stroke. The exhaust-valve arrangement obtains the wrist-plate motion directly on each bonnet, without the use of a separate wrist-plate stand, and also brings less strain on the exhaust-bonnets.

The steam-valve arrangement shown in Figs. 3, 4 and 5 consists of a rocker journaled on a fixed bushing projecting from the bonnet, which bushing surrounds and carries the valve-stem,—a regular rocking motion being imparted to the rocker by means of a link, which connects a pin A at the lower end of the rocker, to the eccentric.

The cam-lever D has a short incline about midway of the length of the cam, thus dividing it into two parts, each of which is a segment of a circle, so arranged that its centre will coincide with the centre of the valve-stem when that segment is held between the rollers E E; so that in operation there will be no change in the relation of the cam-lever and the attached driving-toe, G, with the rocker, except when the incline of the cam passes between the rollers. At the beginning of the forward movement of the rocker, A, the outer portion of the cam-lever D will ordinarily be between the rolls, and the driving-toe G raised to its engaging position with the latch L. As the rocker advances and opens the valve, the incline of the cam enters between the rollers, causing the driving-toe to be depressed sufficiently to release the latch, and the valve is immediately closed by the dash-pot. On the return movement of the rocker, the incline of the cam returns between the rollers and raises the toe for subsequent engagement with the latch, and as the toe comes back to its first position, the latch is raised by contact with the upper side of the toe, and then drops in front of the toe for engagement again. It is obvious that the angular position of the trip-lever, F, which is controlled by the governor, will regulate the amount of opening of the valve and the proportion of the engine stroke when steam is admitted to the cylinder. Both latch and toe are provided with hardened steel plates, each with eight edges which are available for wear.

The centre of the pivot of the latch is considerably above the line of pressure on the latch, so that the latter will be prevented from rising while at work, and a large amount of wear on the engaging-surfaces has to take place before the latch can jump out of its engagement. This is an important feature of the gear, as by it the builders are enabled to use a light gravity latch, without the use of springs, and at the same time the latch is automatically locked in place when at work.

The governor is of the well-known, high-speed, Porter type,

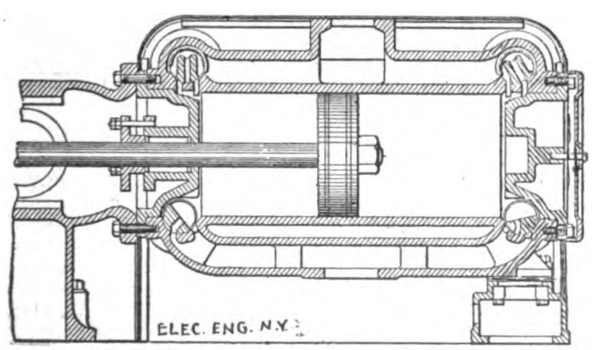
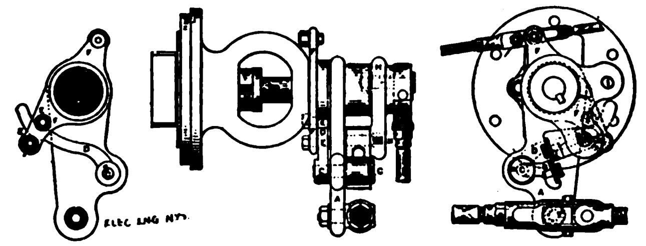


FIG. 2.—CYLINDER OF RICE-SARGENT ENGINE.

mounted on the bed-plate, and driven by a belt from the main shaft. The governor runs at a high velocity and is extremely sensitive. A "stop-motion" is provided, which will immediately stop further admission of steam to the cylinder if the governor should be disabled. The dash-pots are a new form of vacuum-pot. They have a constant internal displacement, and do not take in or discharge air at each stroke, and they are absolutely noiseless and free from vibration when cushioning.

A new form of rotary clutch for disconnecting either set of steam or exhaust-valves, for operating by hand, is shown in Fig.



FIGS. 3, 4 AND 5.—RICE-SARGENT VALVE GEAR.

1. This consists of a steel tube with a long slot on each side containing notches, which fit corresponding teeth projecting from the valve-rod inside. The tube is rotated by a ball handle, the weight of which holds the clutch in or out.

Special attention has been paid to thorough and continuous oiling for all bearings, and a double sight feed lubricator and hand oil pump are provided for the proper lubrication of the cylinder. Owing to the short movements of the valve-gear, these engines will run at a much higher rotative speed than the usual form of Corliss engines. The engine is built in all sizes from 12 in. cylinder, up, either single or multiple expansion.

NEW YORK NOTES.

THE NEW YORK FIRE DEPARTMENT is examining civil service candidates for an inspector of its electrical wires and appliances. The examination began on March 29.

MR. E. W. STEVENSON, E. E., lately with the Norwich Insulated Wire Co. as electrician has become associated with the Okonite Company, with headquarters at the Passaic factory.

MR. LUTHER STIERINGER has started on a southern trip beginning at Nashville, N. C., and extending as far as New Orleans. It will be for pleasure, but Mr. Stieringer has a business eye.

THE GOUBERT M'F'G. COMPANY, New York, makers of the Goubert Feed Water Heater and Stratton Steam Separator have lately removed their Pittsburgh office from 408 Lewis Building to 1012 Carnegie Building.

MR. U. G. CROFT of General Electric Company, and for many years with the old Thomson Houston Co. has resigned and enters the field as a Contracting Engineer. He is interested in enterprises on Long Island and has closed several contracts for lighting at Sea Cliff and Oyster Bay. Business in that section of the Island looks very promising.

GENETT AIR BRAKES.—The Genett Air Brake Co., of 38 Wall street, have made immense strides lately in the further perfection of their excellent brakes, and to clear the way are now offering for sale a limited number of the old style air pumps, which will be found extremely useful for a variety of mechanical purposes. They are strong, good and cheap.

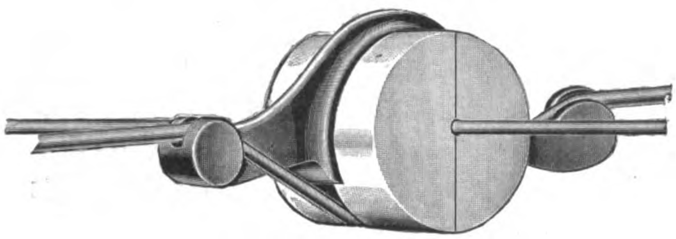
GOULDS MFG. CO.—TRIPLEX POWER PUMPS.

The Goulds Mfg. Co. has just begun the erection of a new addition to its extensive works at Seneca Falls, N. Y. The construction of this building is necessitated by their steadily increasing business in triplex power pumps. The building will be a modern structure of the slow-burning type. Its length is 86 ft. and width 85 ft. The frame work, beams, columns and roof truss will be of steel. The building will be two stories in height with basement for storage of castings. The main room for heavy machines and erecting purposes will be 22 ft. high and served by an electric bridge crane of 10 tons capacity. The gallery will divide one side into two stories for lighter machine tools. The walls will be of brick, while the skylight and upper windows will be glazed with ribbed glass. The entire main floor is designed to stand a uniform strain of 400 lbs. to the square foot, although a limited area is capable of bearing 600 lbs. to the square foot. It is expected that the building will be completed about June 1st.

M. E. MERCADIER, telegraph engineer and director of studies at the Ecole Polytechnique in Paris, has been named "Officier de l'Instruction Publique" in the Legion of Honor.

THOMPSON-BROWN GUARD WIRE INSULATOR.

We illustrate in the accompanying engraving a new guard wire insulator which is being introduced by the Thompson-Brown Electric Co., of Boston. It is made of vitrified porcelain and malleable cast iron, and is strong, effective and simple. As will be seen, the guard wire passes through the centre of the insulator,



THOMPSON-BROWN GUARD WIRE INSULATOR.

while the supporting wires pass over the bracket and underneath the insulator, which is made in two halves so that it can be easily applied at any part of the line. This guard wire insulator forms another link in the very complete set of overhead line material recently got out by the Thompson-Brown Co., and being so simple and cheap, will readily recommend itself to all electric railway engineers.

BIDS FOR AN ELECTRIC PLANT AT FORT DELAWARE, DEL.

Bids were opened by Lieut. Spencer Cosby, U. S. Engineer's office, Philadelphia, Pa., on March 22d, for the materials for an electric plant at Fort Delaware, Del. The bidders were as follows:

International Trading & Electric Co., New York, N. Y., two stationary engines, 25 H. P., $810 each; one stationary tubular boiler, 60 H. P., $572.25; two direct current compound wound multipolar generators, $912 each; one switch board and testing apparatus complete, $676.50.

McCay-Howard Engineering Co., Baltimore, Md., two stationary engines, 25 H. P., $440 each; one stationary tubular boiler, 60 H. P., $470; two direct current compound wound multipolar generators, $590 each; one switchboard and testing apparatus complete, $445.

Westinghouse Electrical & Manufacturing Co., Pittsburg, Pa., two stationary engines, 25 H. P., $514 each; one stationary tubular boiler, 60 H. P., $650; two direct compound wound multipolar generators, $688 each; one switchboard and testing apparatus complete, $401; one electrical locomotive, series wound, single reduction multipolar motor, $1,200.

The Electric Construction & Supply Co., Wilmington, Del., line necessaries, $432.34.

The following bids have been recommended for acceptance:

McCay-Howard Engineering Co., Baltimore, Md., engines, boiler, generators, etc., $2,975.

Westinghouse Electrical & Manufacturing Co., Pittsburg, Pa. electric locomotive, $1,200.

The Electric Construction & Supply Co., Wilmington, Del., line accessories, $432.34.

THE UNIVERSAL NON-ARCING LIGHTNING ARRESTER.

EXPERIENCE has shown that dependence cannot be placed on lightning arresters situated in the station alone, and that it is far better to deflect the lightning discharge from the circuit outside the station and thus prevent its entering where it has a chance to damage valuable apparatus. Lightning arresters are therefore equally necessary distributed at frequent intervals on the poles carrying the conductors; but a successful arrester of this type must be so constructed that while affording protection it requires no inspection or manipulation and is ready to do its work at all times.

It is with these essentials in view that the "Universal" non-arcing lightning arrester has been designed and recently brought out by the Oakman Electric Co., of 136 Liberty St., New York. Fig. 1 shows it in section and Fig. 2 attached to a pole carrying the conductors. (The cuts appear in the advertisement on page XIII.)

As will be seen, the line and ground wires are each connected to toothed plates of non-arcing and non-fusible metal insulated from each other. Between these toothed plates and supported on rods of insulating fibre are a series of plates of the same material separated by sheets of mica. This construction, while insulating the line throughly from the ground for the normal current passing in the conductor, nevertheless forms a ready path for a lightning discharge, the character of the metal plates employed making the formation of a continuous arc impossible. As a result any number of discharges may pass to ground in quick succession without necessitating any manipulation or inspection of the arrester, and making it impossible for the dynamo current to follow.

The arrester is covered by a hood of tin and mounted on a porcelain base, giving it a neat appearance.

PHILADELPHIA NOTES.

THE METROPOLITAN ELECTRIC CO., at Reading, Pa., have placed the contract for their new power house with the Berlin Iron Bridge Co., of East Berlin, Conn.

THE SOUTHWARK FOUNDRY AND MACHINE COMPANY, of Philadelphia, have contracted with the Edison Electric Illuminating Co., of New York city, to build a vertical quadruple expansion non-condensing engine for their Duane street station. This engine will develop 2250 H. P. with highest economy, and a maximum of 3000 H. P. It is intended to drive two 800 K. W. generators, one on each side of the engine, directly connected to the crank shaft. It will run at a speed of 90 revolutions per minute and under 200 pounds initial steam pressure.

NEW ENGLAND NOTES.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., report the sale through Messrs. H. B. Coho & Company, their New York contractors, of one 30 K. W. and two 50 K. W. direct connected generators of their new type for Grace Chapel, Seventeenth street, New York City. Armington & Sims engines will be used.

WESTERN NOTES.

MR. O. M. HUBBARD, Manager of the Cincinnati office of the Bradford Belting Co. spent several days in Chicago last week on business connected wtth the opening of their Chicago office.

MESSRS. KOHLER BROS., Chicago, have just closed a contract with the Chicago City Railway Company for the furnishing of 49 car equipments of the Walker Mfg. Co.'s standard make.

WISCONSIN UNIVERSITY.—The junior electrical and mechanical engineering students have laid out a schedule of visits in Chicago, Milwaukee, Joliet and Waukegan for the trip of annual inspection.

MR. W. C. TEMPLE, Pittsburg, of the firm of H. E. Collins & Co. was in Chicago last week on business connected with the Cahill water tube boiler, for which his firm is the general selling agent.

MR. L. A. FARNSWORTH, formerly representing the Jenney Electric Motor Company as Chicago agent, has opened an office as electrical contractor in the Monadnock Block, and has already secured several nice contracts.

THE ELECTRIC APPLIANCE COMPANY have just issued a descriptive circular of their improved Hunnings telephone, and American Telephone switch board, which sets off the above goods to advantage. Their switch-board is a very neat and artistic device, and they claim notable advantages in their battery telephone.

THE BRYANT ELECTRIC COMPANY has a new device which might be called a combination cleat and rosette. It consists of a cleat about the size of an ordinary porcelain cleat and in the internals of this new production are all the details of an ordinary ceiling rosette.

THE RACINE HARDWARE COMPANY'S Catalogue of Automatic Engines, second edition, has recently been issued and deserves the attention of all contemplating the purchase of a first-class high speed engine for electric light or power purposes. Their vertical engines are now made with a special sub-base to take a dynamo of any standard make, enabling a direct connected outfit to be placed in a very small floor space.

TELEPHONE COMPETITION IN NEW YORK AND BROOKLYN. It is stated that telephone competition is to be organized in this part of the world by the Mutual Automatic Telephone Co., a branch of the state company known as the Automatic Telephone & Electric Co. operating the Strowger system. The local company is said to control for ready use $6,000,000 of capital. Its board is:—Smith M. Weed, chairman; J. W. Allison, president; S. B. Dutcher, first vice-president; J. C. McGuire, second vice-president; H. N. Whitney, treasurer; A. B. Macklin, secretary.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. APRIL 10, 1895. No. 362.

ELECTRIC LIGHTING OF THE NEW YORK & BROOKLYN BRIDGE CARS.

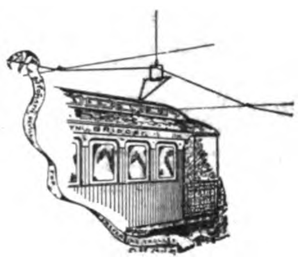


Fig. 1a.

AFTER five months of impatient waiting on the part of the public, and of laborious and painstaking effort on the part of the contractors, the electric lighting of the bridge cars is an accomplished fact. For years the question of improved lighting service in these cars has been agitated; but it was only last Spring that the Trustees gave heed to the popular clamor and advertised for bids. Few contractors cared to respond. The novelty of the undertaking, in some particulars, the difficulty of realizing a profit out of any public works contract when the specifications are lived up to in good faith, and the stringency of the specifications adopted were discouraging.

The first advertisement called upon contractors to furnish examples of what they could do, at their own expense, at the same time submitting their own specifications and estimates on installation and operating expenses. This was done; but, on account of the difficulty of reducing the various bids to a standard basis of comparison, the deliberations of the Board of Trustees became a struggle between Pintsch gas versus electricity. The latter won the victory last Fall, when the Board authorized its

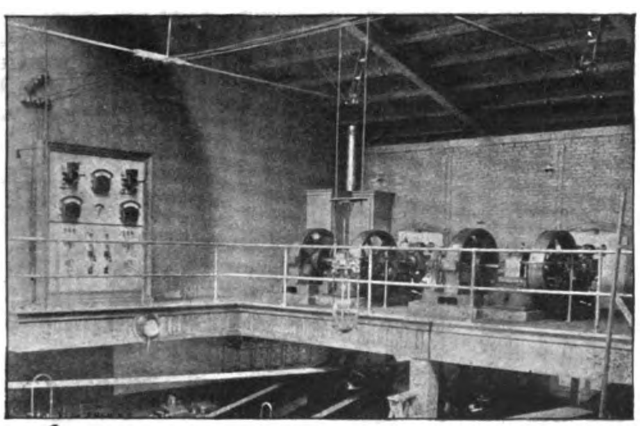


FIG. 1.—GENERATING PLANT IN BROOKLYN BRIDGE POWER HOUSE.

chief engineer to advertise for bids for electric lighting. In the mean time one company had put in operation on one of the cars an exhibition plant consisting of a storage battery charged by a dynamo driven from the car axle. For some reason the authorities did not favor this method, and its advocates gradually dropped to the rear.

Bids for electric lighting were opened in September, and all hoped that the matter would be decided at once; but a new obstacle arose in the shape of the inventor of a sub-trolley system, who pleaded for an extension of time in order to put in a bid, but who was finally disbarred by the Chief Engineer's specifications. These specifications, by the way, were drawn up by Mr. C. C. Martin after it was found to be impossible to bring the bids and specifications submitted by the competitors to a comparative basis. They were about as stringent as they could well have been made, and the fact that they have been followed so closely in work of such unusual character speaks well for the care originally bestowed upon them by Mr. Martin.

The generating plant, situated in the Brooklyn power house and illustrated in Fig. 1, consists of two units, each unit being made up of an Armington & Sims 40 H. P. horizontal high speed automatic cut-off engine, direct connected by a solid shaft to a 25 K.W. General Electric multipolar compound wound 500 volt generator, the normal speed of which is 300 revolutions. A white Italian marble switchboard, framed in polished oak, carries the following instruments: A Carpenter rheostat for each generator; a

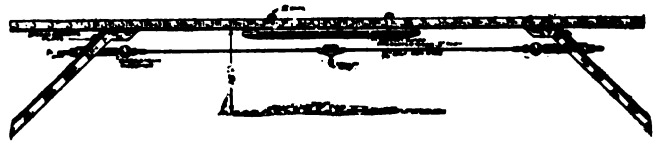


FIG. 2.—METHOD OF SUPPORTING TROLLEY WIRE.

Weston illuminated dial ammeter for each circuit; a quick-break knife-blade switch for each side of the circuit; a fuse block for each side of the circuit; a circuit breaker for each generator; a three-pole knife-blade switch for each generator; one Weston illuminated dial voltmeter, and a galvanometer switch. By an ingenious method of wiring, devised by Mr. Brenner, who has been in charge of the installation throughout, the galvanometer switch is employed in conjunction with the standard voltmeter, for determining when the pressure at the brushes of the two machines is equal. This does away with the use of a balance galvanometer or an extra voltmeter when throwing two machines in multiple. The method of connection as well as the general arrangement of the circuits is shown in the diagram Fig. 3.

Under the specifications, current for a maximum of 480 lamps is required, so that practically one unit, delivering 50 amperes at 500 volts can take care of the entire load. The second unit is therefore a reserve, and can be used if desired for furnishing incandescent lights for the stations.

Owing to the crowded floor space in the dynamo room, the car lighting plant was of necessity placed on a gallery.

The specifications called for an overhead trolley line of No. 00 B. & S. hard drawn copper, doubly insulated throughout. Fig. 2 illustrates clearly how the double insulation was obtained on the suspended structure. Under the tower platforms, however, the creosoted wood backing gave place to a creosoted wood trough, similar in appearance to that used beneath the elevated railroad structure in Brooklyn.

Fig. 4 is a view of one of the graceful bracket poles used on the approaches. The flexible suspension and double insulation methods are adhered to here, as elsewhere. In fact, the aim has been to give the trolley wire as much lateral flexibility as possible, with a view to sav-

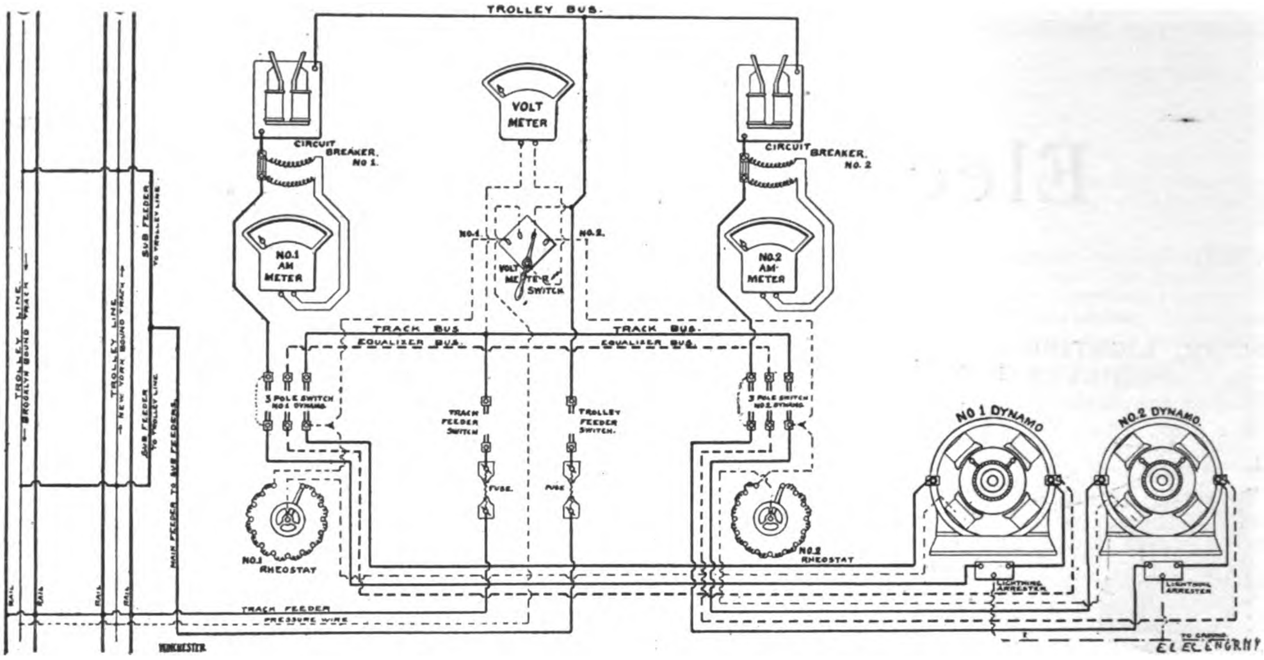


FIG. 3.—DIAGRAM SHOWING CONNECTIONS BETWEEN DYNAMOS, SWITCHBOARD AND TROLLEY SYSTEM.

ing clips and hanger studs from shocks. The line hangers are of the General Electric cap and cone type, the ball insulators are the General Electric "spherical strain," and the clips, consisting of body, tempered copper saddle and wedge, are from the N. Y. Electrical Works. Trolley wire was furnished in exact lengths by Wallace & Sons, and the span wire by J. A. Roebling's Sons Co.

As the rails upon the suspended structure are practically insulated from earth by the creosoted ties, great attention has been given to the bonding. Each joint is bonded with a Vail single cable bond equal to a No. 1 B. & S. wire. At intervals of 500 feet the rails are cross bonded, and the two tracks are connected together. At the same intervals the trolley wires of the two tracks are looped together. The drilling and bonding was done while trains were passing and repassing, the headway between trains varying from 1½ to 3 minutes.

The trolley wire is fed by a No. 0000 B. & S. cable, double rubber covered and braided, extending from the switchboard to the centre of the river span, where it branches into two sub-feeders, each a No. 0 B. & S. wire, running back to the New York and Brooklyn towers respectively. These feed wires were put in place while the trains were running, but the trolley wire itself was strung little by little during the hours between 1 and 5 A. M.—on one of which occasions the thermometer registered but 5 degs. above zero as dawn approached and the men quit work. The line is drawn taut, and frequently anchored, the method of anchoring being shown in Fig. 5. The anchors are of special design, manufactured from designs of the contractors by the N. Y. Electrical Works.

The line proper claims but one extreme departure from ordinary methods. This is the expansion joint. Temperature changes in the length of the trolley wire are practically balanced by those in the bridge structure itself; but allowance had to be made for the yielding of the bridge under live loads. In the original design of the wonderful, web-like structure, provision was made for this by introducing a "slip-joint" at the centre of each of the

FIG. 4.—POLE AND BRACKET ON APPROACHES.

FIG. 5.—ANCHOR LINE CONSTRUCTION.—ENTRANCE TO SUSPENDED STRUCTURE.

three spans. The play at each "slip-joint" varies from 8 to 18 inches. At these joints the trolley wire was anchored, one end being fastened to a specially designed expansion joint by a mechanical clip, the other end playing freely in and out of a 20-inch brass tube attached to the joint in question. By this telescoping arrangement the trolley line remains taut under all conditions, electric connection being maintained by looping around the joint by means of a cable wound into a helical form.

The line is anchored at the New York end by two poles of the standard type, reinforced by struts and tie rods. The method of anchoring the Brooklyn end is shown in Fig. 6.

The poles are of the standard tubular pattern, furnished by Morris Tasker & Co. They rest in specially designed bases, into which they are leaded, the bases being secured to the brick coping by expansion bolts passing down through the granite coping stone into the brick work. Permission to use the Wallace Electric Company's patented flexible bracket suspension was obtained; working drawings were made, and it was then found that the cost of the brackets, if purchased under contract, would render them extremely

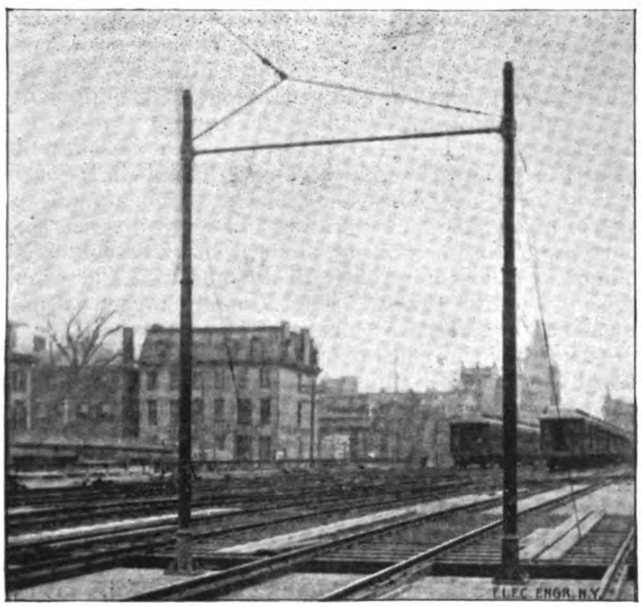


FIG. 6.—ANCHOR POLES, BROOKLYN END.

expensive. In this emergency the contractors rented parts of machine shops and foundries, and undertook the manufacture themselves, the result being brackets made exactly as desired and at 50 per cent. of the figures quoted by the lowest bidders.

Until the line construction was completed, a standard trolley wheel on a short pole was contemplated. Standard overhead switches from the N. Y. Electrical Works were therefore employed. The car equipment consists of two circuits of five 16 C. P. lamps each. Each circuit is controlled by a General Electric combined switch and cutout. The lamps are carried on goosenecks attached to the sides of the car, five on each side, and all wiring is concealed by mahogany moulding stained to match the trim of the car. To avoid flickering, and also to ensure the continuity of the light in case of the failure of any one trolley, all four cars of each train are connected together by tow-car couplers, a trolley being provided for each car. Fig. 7 is an interior of one of the electrically equipped trains. Every precaution has been taken against failure, there being two ground wires to each car, one leading to each truck.

The designing of the trolley base was one of the great-

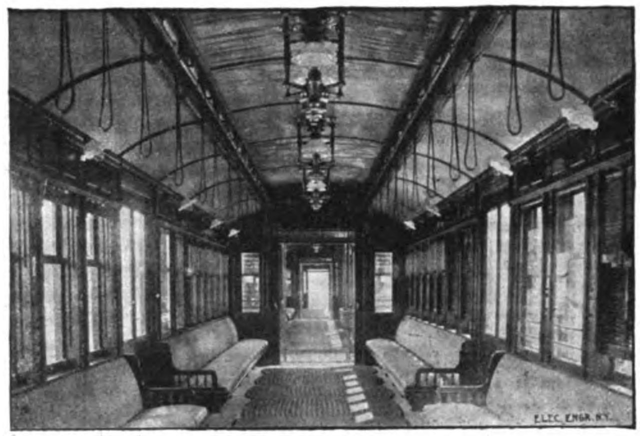


FIG. 7.—INTERIOR OF A BRIDGE TRAIN.

obstacles to overcome. At the outset this seemed quite simple; but in the end it proved to be a very serious matter. The conditions which confronted the designer, Mr. A. E. Winchester, were these: Space between car roof and trolley wire (on suspended structure), 9 inches; arm to trail in either direction without reversing the base; arm to reverse automatically at either end of the line; tension or relaxation of the springs to be controlled from the platform of the car. The trolley shown in Fig. 8 is a solution of the problem. The rod extending from the base to the bell crank lever is controlled by the guard on the platform.

With the design of the trolley base all trouble was supposed to have been passed; but such was not the case. Extreme care was taken in the alignment of the trolley wire, until a plumb line dropped from the centre of the wire on a straight line would have landed exactly midway between the rails. The curves were adjusted with the same fidelity to exactness. A car was run over the line early one morning when all good people were supposed to be asleep. This car carried the trolley depicted in Fig. 8, equipped with a Robinson wheel. The wheel refused to stick to the wire even on the straight line. The original pole, 18 inches in length, then gave way to a 24-inch pole, and this in turn to a 30-inch pole. In all cases the result was the same; and the carefully adjusted wire in which so much pride was taken was then set so as to be directly over the centre of the car roof. To attain this result the hangers had to be moved in some instances eight inches out of centre.

Since the wheel still refused to stay on the wire, owing to the short pole and the thrust of the car at rail joints, it and the arm were discarded altogether, a triangular device carrying a brass tube 18 inches in length taking their places in the socket of the trolley base. This gives a mixed sliding and rolling contact, and is amply sufficient to meet the conditions. It is capable of carrying many

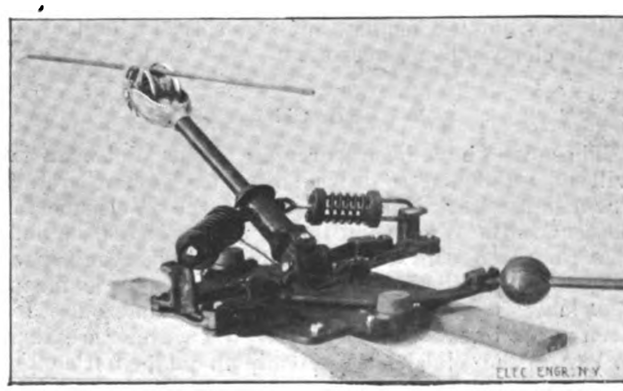


FIG. 8.—TROLLEY BASE AND WHEEL.

amperes, whereas the ordinary maximum current taken by each trolley is less than 1½ amperes. Fig. 9 illustrates the trolley which is now in actual service.

The reversing arrangement appeared simple. Originally it consisted in merely looping up the trolley wire until it was high enough for the trolley to clear it entirely and stand upright. Practically, it was found necessary to add a swinging stirrup, which trips the trolley passing under it, and insures the trailing of the latter in the proper direction. This stirrup which is shown in Fig. 10, is covered with rubber hose, to prevent its abrading the trolley. No solder has been used in clips or anchors, all the fastenings of this nature being mechanical. The difficulty of handling a solder pot when hanging on by one's very teeth in a gale of wind, the rapidity of the cooling process in carrying the molten alloy from the furnace to the joint, and the fear of arousing the wrath of the public beneath by a rain of spattered metal, led the contractors to avoid its use entirely.

The contract called for the equipment of station, line and sixty cars without interrupting travel. This has been accomplished, and the Electrical & Mechanical Engineering Co. deserve great credit for the boldness with which

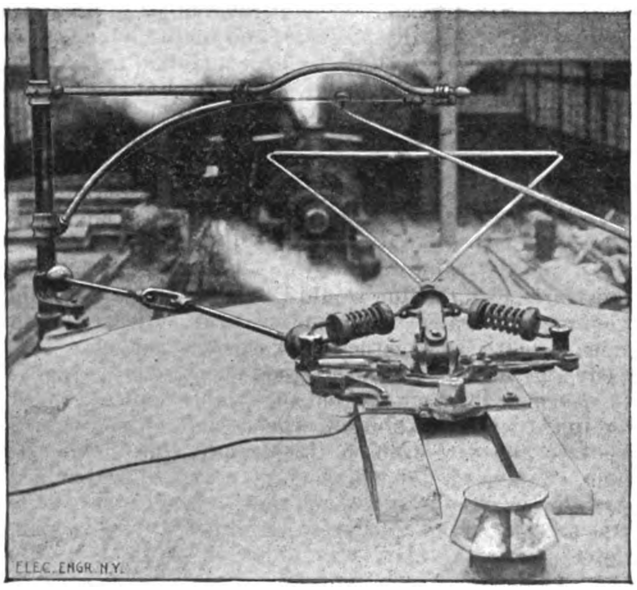


FIG. 9.—TROLLEY BASE AND ROLLER CONTACT.

they took up the project, and the pluck which has enabled them to overcome the unexpected difficulties which confronted them. While the amount of the contract was $18,135, it is safe to say that the profits accruing directly to the company on account of the installation are not in any way commensurate with the merits of the work; and Mr. Vail and his associates will have to content themselves with the honor of having not only saved many bridge patrons from the oculist, but also solved a difficult problem in electrical engineering.

WELSBACH LAMPS.

Those who have been worrying about Welsbach lamps will be interested to learn from the Camden N. J. *Telegram* that "work is getting slack in the Welsbach Incandescent Light Works and the employees have been notified that the place will shut down in April." Against which may be placed the fact that makers of electric incandescent lamps were never busier or more numerous. It has been noted in many cities that as the warmer weather approaches, the Welsbach lights are abandoned. People cannot endure the heat they engender, although in winter it does not bother them much.

CLASSIFICATION AND SELECTION OF LIGHTING SYSTEMS.

BY

Francis B. Crocker

ELECTRIC lighting classification like that of almost any other analogous subject is more or less arbitrary and is adopted merely for convenience. Considered in this light, classification is a great help in the study of any subject, but we should carefully avoid the common mistake of forcing it too far by attempting to make the facts fit the classification, instead of the classification fitting the facts.

Electric lighting apparatus may be classified with reference to various considerations. For example, it may be classified with reference to the system as a whole or with reference to some of its most important elements or characteristics.

Central Stations and Isolated Plants.—Considered as a whole, electric lighting systems may be divided into two important classes—central stations and isolated plants. These two classes sometimes merge into each other and peculiar cases might occur which would be on the dividing line, but ordinarily the distinction between the two is radical and introduces considerable differences in design, construction and operation. In fact these two types of plant must be considered as quite different problems in electrical engineering, and usually there is no difficulty in distinguishing between them. A central station electric lighting system is usually extensive and elaborate technically and quite complicated and difficult in its business management. It consists of a large and complete collection of machinery for generating and controlling the electric current. This generating plant is usually contained in one or more buildings entirely devoted to it and probably specially built for it. The central station is usually owned and operated by a company having no other business. From the central station a large number of electrical conductors run out in every direction. These conductors supply electric current to feed lamps for many different purposes and for the use of many different and independent customers, and a separate measurement or estimate of current and charge therefor is made for each customer.

Isolated electric lighting plants on the other hand are comparatively small and simple in construction and management. They are usually entirely local, that is, the plant supplies current for lighting a single building or group of buildings. The generating plant or machinery is ordinarily located in the cellar or some small portion of the building. An isolated plant usually supplies current only to its owner or his tenants and is owned and operated by a private individual, company or institution and constitutes only a small and incidental part of its affairs. Light is supplied to the various buildings or parts of the building usually without attempting to make separate measurements or charges, which eliminates the somewhat troublesome element of meters and greatly simplifies the business management.

Incandescent and Arc Lighting.—Electric lighting may also be classified with reference to the *lamps*, that is, we have incandescent lighting and arc lighting systems. A few years ago it could have been said that incandescent systems were operated at constant potential, that is, constant voltage, the lamps being connected to the circuit in parallel; and it could have been said that arc systems were almost invariably operated by a constant current, that is, one having a fixed number of amperes, the lamps being arranged in series. This distinction still holds good to a certain extent, but quite recently there has been an extensive introduction of arc lamps on incandescent circuits with constant potential current. These lamps possess the advantage over the ordinary constant current lamps that

the current is of low potential, that is, only about one or two hundred volts instead of two to five thousand volts which is usually employed on constant current arc circuits and is a dangerous current. We also have incandescent lamps sometimes operated on the constant current circuit, being called series-incandescent lamps, but these are not very common, and the use of them does not seem to increase to any very great extent.

The advantages of incandescent electric lighting are:

The fact that lamps of any desired size from one candle power to several hundred can be obtained and easily substituted one for the other and can be operated successfully on any incandescent lighting circuit. The light is soft and agreeable in quality, being in that respect even better than a very good gas-light. It is steady and practically free from danger of setting fire even to the most inflammable material. The lamps can be put in almost any place or position. The wires required to feed an incandescent lamp are small and can be easily placed in fixtures, mouldings, etc., and thus concealed.

The arc light on the other hand has the advantage of being simpler and cheaper to install, particularly in regard to wiring and it gives more light for a given amount of electrical energy than an incandescent lamp. The ordinary arc lamp consumes 10 amperes and 45 volts which is 450 watts and it gives about 350 candle power (i. e. mean spherical). This is at the rate of about 1.3 watts per candle power. The ordinary incandescent lamp requires 110 volts and .5 ampere which is 55 watts and gives 16 candle power. This is at the rate of about 3.5 watts per candle power. Therefore the arc lamp gives nearly three times as much light for the same amount of electric power. To offset this advantage, however, the arc lamp is quite limited in the range of its candle power; that is to say, to obtain good results an arc lamp requires a minimum of about 40 volts and 8 amperes which gives about 300 candle power. If it is attempted to make an arc lamp very much smaller than this in power, it is apt to be unsteady and liable to go out entirely, but considerable progress is now being made with small arc lamps. It is possible to make arc lamps of greater candle power than the ordinary to almost any extent even as high as several hundred thousand candle power, but such lamps are only used for special purposes such as search lights. Hence the arc lamp is not suited to places where small amounts of light are required or where a uniform distribution of light is wanted.

In some cases arc lamps have been arranged to throw all their light upward against a whitened ceiling. In this way the direct light of the arc is not visible and the indirect illumination obtained is much softer and more distributed. This plan has been quite successful in several places, and makes the arc lamp applicable in many places in which the incandescent lamp would ordinarily be employed.

The arc light is also objectionable because its great intensity and the glaring quality of its light are disagreeable or even actually injurious to the eye unless it is shaded by porcelain or ground glass which absorbs about half the light and sacrifices a large part of the power and economy. The color of the light, however, is almost pure white and closely resembles sunlight in its quality, and is therefore sometimes desirable in shops, factories, etc., where colors are to be brought out in their true relations or photographic operations are carried on. In a general way it can be said that incandescent lamps are suited to interior lighting and to comparatively small spaces, whereas arc lamps are adapted to outdoor lighting or to large spaces, such as railway stations, etc.

The arc light is often used for temporary illumination where work is being done in excavations, buildings, etc., at night. Its advantages in these cases are its great power and the simplicity of wiring needed. The engines and dynamos employed for arc lighting do not require to regulate so perfectly as for incandescent lighting and this is also an advantage for temporary installations since it avoids the necessity for very fine machinery, or careful setting and adjustment of the same.

Alternating and Direct Currents.—The third classification of electric lighting systems is in respect to *current* and we have direct current and alternating current systems, the direct current being one which flows in one direction only and the alternating being a rapidly reversed current. The following table shows the various forms of direct and alternating current systems that are employed.

Direct Current.	Dynamos alone.
	" and auxiliary secondary battery.
	" " dynamotors.
	Primary batteries.
Alternating Current.	Dynamos alone.
	" and transformers.
	" " "step up" and "step down" transformers.

The general advantages of the direct current system are:

The potential or voltage employed is low. This applies, however, to incandescent and constant potential arc lamps and not to constant current arc lamps. The direct current also possesses the advantage that motors of any desired size can be connected to the circuit and operated very satisfactorily. Direct currents are also suited to electroplating or other electro-metallurgical or electro-chemical purposes and storage batteries can be used with them. Direct currents are also largely free from peculiar actions and losses due to self-induction and electrostatic capacity which may occur in the case of alternating currents. The great advantage of the alternating current is due to the fact that it can be generated at a high potential, usually 1000 or 2000 volts and transmitted a considerable distance over a comparatively small wire without serious loss. This economy in the size of wire required is due to the fact that since the potential in volts is high the current in amperes and therefore the cross-section of the wire needed is small. When a point where lights are to be run, is reached, the voltage is brought down by means of transformers to, say, 50 or 100 volts and wires may be run about a house, for example, and carry this low tension current which has thus been made harmless. This ability to transform the alternating current from one voltage to another, as desired, by means of simple induction coils having no moving parts, is the great advantage to which the alternating current almost entirely owes its importance. The alternating current also has the advantage of requiring no commutator on the dynamo which generates it, two simple collecting rings being sufficient; but a separate machine or winding is required to furnish a direct current to excite the field magnet and this involves a commutator.

The alternating current can also be regulated by means of the counter-electro-motive force of a "choke coil" which shuts off the current without wasting so much energy as the simple resistance coils used to control direct currents. Storage batteries cannot, however, be used with the alternating current. The relative merits and economy of the direct and alternating current systems have given rise to more discussion than any other subject in electrical engineering and the question is still an unsettled one, even the most competent authorities not being agreed upon the matter. This problem involves a great many fine points, and would depend upon the conditions in each particular case. It is discussed more fully later in its bearing upon the problem of selecting a system in a given case. In this connection it is one of the most important questions which an electrical engineer is called upon to decide.

High and Low Potential.—The fourth and last classification of electric lighting systems is with reference to the use of "high tension" and "low tension" currents. The term ten-

sion, however, is old-fashioned and was formerly employed to designate what we now call potential or voltage. It is impossible to exactly define what constitutes a high tension system since much depends upon the circumstances and the point of view. If we look upon the question in its relation to fire risk or insurance we find that anything over 250 volts is called a "high tension" system and is covered by a different set of rules.[1]

If we view the matter as electrical engineers, where many other elements beside fire risk have to be considered, we find that the National Electric Light Association has defined a high tension system to be one using 350 volts or more.[2] The reason for this higher limit is possibly the fact that anything under 350 volts is almost perfectly safe so far as danger to persons is concerned and the problem of insulating and controlling electric currents under 350 volts is not difficult from the engineering standpoint, and various constructions are allowable which would not be proper for high tension systems of 1,000 volts, for example. If we consider the question solely from the point of view of personal danger, that is, liability to fatal accident, then we can probably place the limit at 500 volts, because thousands of miles of circuits carrying currents of 500 to 600 volts are in use in this country for operating electric railways and the records show that there have been very few fatal accidents produced by the *current* from these circuits.

Thus we see that there are several different definitions of high and low tension systems according to circumstances, and each may be perfectly correct from a certain point of view. In electric lighting there is usually no difficulty in distinguishing high and low tension systems since practically the only circuits now used in this country are the alternating current of 1,000 to 2,500 volts, the arc system of 2,000 to 5,000 volts, or the direct current incandescent (and arc) circuits of 110, 220, or at most, 250 volts. The five-wire system sometimes adopted in Europe and operated at about 440 volts would usually be called high tension and so would most series incandescent systems.

LIEUTENANT FISKE'S RANGE-FINDER.

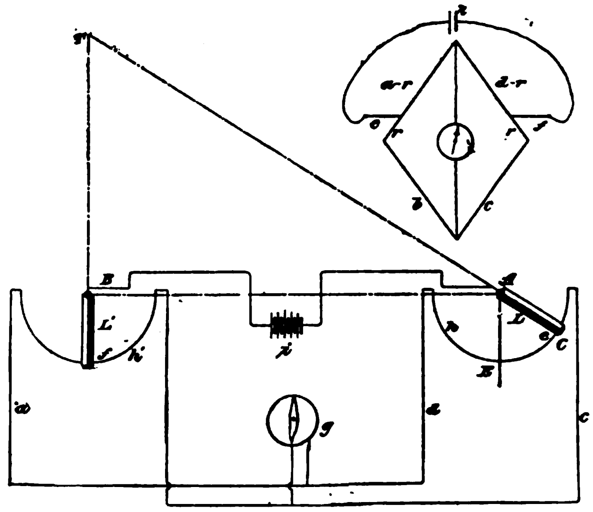
The Fiske range-finder and its method of construction, which has been described in these columns,[3] has now been tested for somewhat more than five years and has finally been adopted by the United States Navy. It has naturally undergone some changes during the process of evolution, and we now show the form which it has finally assumed. It will be remembered that the instrument is based, as far as the general principle goes, on the measurement of resistances of a conductor, in the form of a Wheatstone bridge, there being two arcs of wire at the ends of a base line, each arc corresponding to two contiguous members of the bridge. Two telescopes are located at the ends of the base line and carry contacts which move over the wire as the telescopes are turned in the angle to be pointed upon any object.

Let Fig. 1 represent the arms of a Wheatstone bridge bent into the form of an arc h', while c and d are bent into the form of an arc h, both of these arcs being wires of conducting material. Let telescopes, pivoted at A and B, be fitted with the contacts e and f. Now, if the extremities of the semi-circular arcs are in the same line, the contacts carried by the telescopes will press on the middle parts of their respective arcs, and the galvanometer will, therefore, not deflect, whenever the telescopes are parallel and at right angles to the base line, because, as shown above, $ac = bd$. But when the telescopes are parallel they are directed at some point in space infinitely distant; that is, the distance of the object towards which the telescopes are directed is infinite. The position of rest of the galvanometer needle is therefore marked "Infinity."

Now, let the telescopes be directed at some point T not infinitely distant. The telescopes will converge and the angle of convergence is clearly the angle ATB, or the angle CAE, which is measured by the arc CE. In other words, the degree of convergence is measured by the difference in the positions of the contacts of the telescopes on their respective arcs. But, if the bridge was in balance when both contacts were at the middle points, it will clearly not be in balance when one is at the middle point of its arc and the other at C; and the amount by which it is out of balance will clearly vary with this difference of positions. That is, the greater the amount of convergence of the telescopes, the greater the deflection of the galvanometer; so that the deflection of the galvanometer varies with the angle ATB. By trigonometry,

$$\text{AT} = \frac{\text{AB}}{\sin \text{ATB}} \times \sin \text{ABT}.$$

From this formula it is plain that, if ABT be a right angle, the distance AT varies inversely with the sine ATB; and it is, therefore, plain that, if the electromotive force of the battery remains constant, the deflections of the



FIGS. 1 AND 2.

galvanometer vary inversely with the distance; so that, if we know the length of base, we may graduate the galvanometer directly in units of distance, remembering that with such small angles as ATB always is in range-finding, the sine of the angle is practically the same as the arc.

But suppose that ABT is not a right angle. Suppose, first, that the target pointed at by the telescopes is infinitely distant, but in a direction inclined to the base. The contacts carried by the telescopes will not now press on the middle points of their arcs, but on points equally removed from the middle points. This is evidently the condition shown in Fig. 2, where the contacts have been moved away from the middle points over equal resistances. The galvanometer will not deflect, but will remain at its position of rest, which position on the galvanometer is marked "infinity."

Let one contact be now moved from its position so that the telescopes converge and point at some object not infinitely distant. The galvanometer will deflect. In order to indicate the true distance of the object, the galvanometer must now deflect, not in proportion to sin ATB, but in proportion to ATB ÷ sin ABT. In other words, it must deflect more for an angle of convergence ATB than if ABT were a right angle; and the smaller ABT is, the more the needle must deflect. In the range-finder this increased movement of the needle is obtained by taking advantage of the curious fact that the current in the

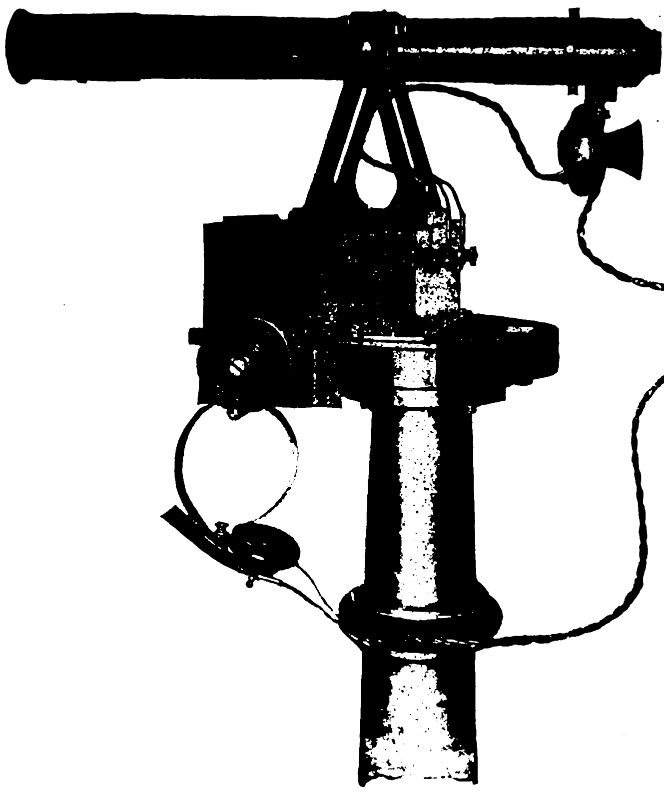
1. National Board of Fire Underwriters' Rules. See "Electric Lighting Specifications." Merrill, p. 153
2. *Rules*, Nat. Elec. Light Assoc. adopted at Washington, Feb., 1894.
3. THE ELECTRICAL ENGINEER, Oct. 1, 1890.

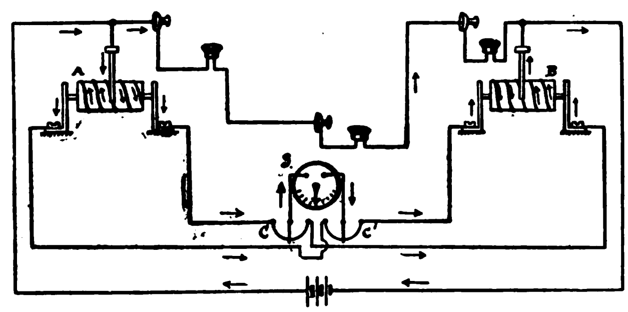
Wheatstone bridge increases as the contact points are moved away from the middle points. This is because the resistance of the bridge is less; so that, if the electromotive force of the battery is constant, the current increases proportionally as the resistance decreases.

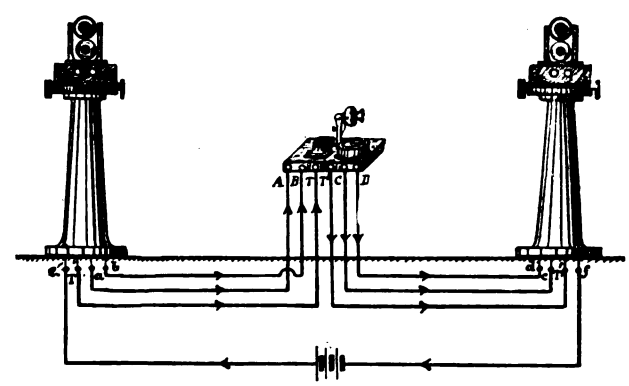
In the apparatus as at present constructed, the wire is not laid in the form of an arc but is wound upon a cylinder of insulating material. A contact presses on this wire and as the telescope above, shown in Fig. 3, is turned in azimuth the insulating cylinder revolves and causes the contact to press upon different parts of the wire. The special feature of value in this construction is that the wire is completely protected from the effects of weather, and, what is of more importance still, it makes it possible to use a device by which the non-uniformity of the wire is automatically corrected.

It has been said above that when the telescopes are parallel, and, therefore, pointing at some object infinitely distant, the contacts carried by the telescopes must press on the resistance wires at similar points; so that the galvanometer G. In case the temperature of either instrument, say B, is raised and its resistance correspondingly raised, it is simply necessary to move the two contacts of the galvanometer G along the arc C C′ a distance sufficient to compensate for the increased resistance of that instrument. In order to tell when this sufficient distance has been traversed it is merely necessary to set both instruments at similar angles and move the two contacts equally on C C′ until the galvanometer shows infinity.

This operation requires a few seconds only, and suffices to adjust the range finder for the temperature conditions which prevail that day. Fig. 5 shows a diagram of the circuit of the range-finder. The two instruments at the opposite ends of the base line with their telescopes and telephones are shown. The arcs *a* and *b* of one instrument are connected to the arcs *c* and *d* of the other instrument, through the temperature corrector which is mounted on the base of the reading instrument shown in the centre. The telephones on the two observing instruments are connected together through the telephones on







FIGS. 3, 4 and 5.—FISKE RANGE FINDER.

vanometer needle will not move from the infinity mark no matter at what angle the telescopes are pointed. In order that this may be always the case, it is evident that we must have an exact equality in resistance per unit length of resistance wires, or else we must have some device by which non-uniformity will be corrected. This is accomplished in the instrument in question by an ingenious arrangement of the contact by which whenever the telescopes are directed at similar angles, the contacts automatically go to such parts of the wire that the bridge is in balance and the galvanometer indicates infinity.

Another important feature introduced in the present apparatus is a temperature corrector, by means of which any change of temperature, either in the climatic or other conditions, and its consequent effect upon the resistance of the circuit is automatically compensated. In Fig. 4 the temperature corrector is shown at C C′ and consists simply of two similar arcs of wire introduced in the circuit between the two observing instruments at the ends of the base line, upon which arcs press the contacts of the the reading instrument and the battery contacts are connected to the storage battery, shown below, which is ordinarily in the dynamo room of the ship. On the same base with the temperature corrector is the galvanometer or reading instrument. The captain of the range-finder crew is stationed in the conning tower of the vessel at the reading instrument and has all the devices for correcting the range-finder under his hand. He has simply to see what figure the needle of the galvanometer points at and telegraph this figure to the guns, by means of the electric range indicator.

Perhaps no electrical apparatus that has come into use in the development of electricity has had greater difficulty in making its way. It seemed hopelessly scientific for the use of the sailor; and its success is merely another indication of the now acknowledged fact that, if an invention be based upon correct principles, and accomplishes a useful purpose, perseverance and good workmanship will, in the end, succeed in adapting it to the practical uses for which it is designed. Lieutenant Fiske's invention

opens a new use for electricity and accomplishes the apparently hopelessly difficult feat of measuring distances at sea. It was intended primarily for use in war, but it has a far wider usefulness in peace. On board the U. S. Naval ships, for instance, the occasion has never arisen to employ it in warfare; but the captains and navigators find abundant use for it in navigating along a coast and going into and out of port.

The curious individuality of this invention has attracted to it the attention not only of naval and military people, but of the scientific world; and the instruments in their earlier forms have been illustrated and described many times in all civilized countries. Yet never has there been any claim made by any one that anybody else ever conceived the idea. In view of the furious battles that have been waged over priority in the invention of most electrical devices, this fact is, to say the least, worthy of remark.

THE ARC LIGHT FOR MUNICIPAL STREET PURPOSES.

BY I. C. WOOD.

Where and how placed.—The methods of arc lamp suspension at present in vogue may be grouped as follows: The lamp is (1) suspended midway from a wire stretched across the street, the wire being fastened to high poles; (2) suspended from a short arm on the top of a pole in the middle of a street; (3) suspended from a long arm on the top of the pole on the sidewalk, generally at a street corner; (4) suspended about 12 feet from the curb from the cross wire which supports the trolley wire; (5) fixed in the top of a pole, either in the middle of the street, or (6) fixed in the top of the pole on the sidewalk.

Which is the best method?—No. 1 permits considerable swinging, consequently much wear and tear, as well as uncertainty of efficiency. In No. 2 the pole, being so near to the light, intercepts the rays and so destroys and wastes light. No. 3 overcomes the fault of No. 1 by giving rigidity, and of No. 2 by increasing the distance between light and pole, the shadow, consequently, being less deep and the light better diffused. No. 4 is a medium between 1 and 3, though, as an extra pole is not necessary, some economy in construction is obtained. The swinging still remains, however, though not so pronounced. No. 5 avoids the faults of 1 and 2 by possessing steadiness and having no pole shadow, but its position in the middle of the street is generally objectionable. No. 6, like No. 5, overcomes the faults of 1 and 2, also of 6, but it has its own peculiar disadvantage of being too near the buildings.

The two having the fewest faults and the most advantages are Nos. 3 and 6. (See Fig. 1.) No. 6 casts no shadow from a pole, but a large portion of its light is intercepted by the building, hence so much of it as is thus stopped is wasted. For instance, a gas jet placed near a partition in a large room, can throw the light only away from one side of that partition, but take the partition away and the jet will illuminate as much space again as it did before, without burning any more gas. The

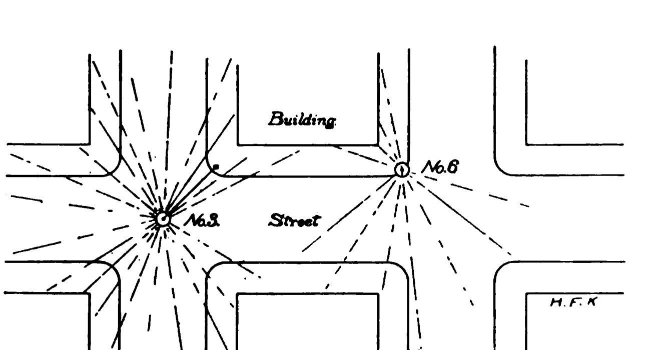


FIG. 1.

same thing applies to the arc lamp that is placed near a blank wall or building; part of its rays are rendered useless. The wall, however, cannot, as could the partition, be moved away from the light, therefore the light must be moved away from the wall.

No. 3 is designed to avoid the faults of all the others, and does so successfully. It is firm; it is away from the building and the shadow from the pole is reduced to the minimum. In No. 3 the lamp is removed away from the wall, and lights up the entire width of the street, while in No. 6 the light reaches little more than half the distance. Should there be trees or awnings in the street the advantages of No. 3 would be still more pronounced.

The usual height of electric light poles in most cities is 35 feet above the ground, and about 5 feet below the ground.

Measurement of Arc Lights.—Candle-power measurement of light is a mythical custom which should be relegated to the company of other reminiscences of the time when "Good King Alfred" counted the hours by notches on his candle. With all the advancement in kind, variety, quantity and quality of lighting which has been made since candles held the field alone, we have no standard of measurement nor a method of testing measurement, befitting the times. Who of us knows how much light 1 or 16, or 2000 candle-power is? Put a light on the street corner and call it 1000, 1500 or 2000 candle-power, and who can prove it is not 900, 1400 or 1900 candle-power respectively?

The question of measurement of light furnished by an arc lamp is probably the most puzzling of any connected with street lighting. Years ago "1600 candle-power" was the standard of measurement; to-day "2000 candle-power" is the standard. But this candle-power standard is not a practical measurement of light, nor is there a convenient method of testing the actual candle-power obtained from each lamp. Electricians have agreed that, under proper and uniform conditions, a consumption of 10 amperes of current at 45 volts (equalling 450 watts) will give an electric light equal to 2000 candle-power. Reducing this to a layman's basis of explanation, we may say that if the machinery in the power house (or station) is producing 10 amperes of electricity (this being the way the current is weighed or measured) and it is sending that current over the wires at 45 volts (pressure) then the light given out by the lamp would be equal to 2000 candle power.

Now comes the question, How can we measure, or test, the lamps on the streets to see if we are getting 2000 candle-power lights? In the first place the mind must be disabused of the idea that an actual 2000 candle power light is being paid for. What is meant by the term "2000 candle-power" is simply this: A nominal 2000 candle power, *as represented by the consumption of a current measuring* 10 *amperes and* 45 *volts.* The description in italics defines the real commodity purchased; therefore the words "2000 candle-power" are superfluous, for it is the quantity furnished that constitutes the fixed article involved, namely, an electric light which has a brilliancy and intensity equalling a "nominal" 2000 candle-power. If, therefore, we are getting 450 watts we are getting a "nominal 2000 candle-power" no matter what we call it. On the other hand, if less than that amount of electricity is furnished, we are getting less than that nominal candle-power. It amounts, then, to this, that the term "2000 candle-power" means a certain supply of electricity and not a particular amount of diffused light. And yet it is true that a light equal to what is technically termed "2000 candle-power" can be, and usually is, diffused from the arc-lamps that are supplied with 450 watts. That is to say, if we have a lamp that can utilize a "nominal 2000 candle-power, as represented by the consumption of a current measuring 10 amperes and 45 volts" and if that amount of current is applied to the lamp, and the carbons in the lamp are of the best quality and properly trimmed, then the light diffused will be what is accepted as "2000 candle-power."

The test, then, must relate first, and chiefly, to the amount of electricity furnished, and as there are instruments in every station which correctly register the output, any one can, at any time, see whether the required quantity of electricity is being generated. As there is always some loss of current between the station and the lamps on the street, there ought to be a slight excess at the power-house. If there is doubt that the electric current which reaches the lamps is of the required standard, each lamp may be tested by a portable instrument by making connections at the lamp. This is a simple operation, but to ensure accuracy an electrician should be asked to perform it.

Supposing, then, that the test at the lamps shows the required number of watts, and yet the light is poor and excites suspicion that less than "2000 candle-power" light is being diffused, the trouble will be found in the lamp or carbons, and not in the current. It may be traceable to a defect in the construction of the lamp; or it may be that the carbons used are not of a proper quality; or that the trimmer has performed his work of placing the carbons in position in a careless manner Each of these troubles will reduce the effectiveness of the current, and the net amount of diffused light. As it is diffused light that the people really want, and what they would like to pay for according to the amount obtained, this absence of an easily available and accurate means of testing the intensity of the light, is a thing much to be regretted. Without such a test there can be no real measurement of the light furnished, and we must, therefore, be satisfied to know that the amount of electricity furnished is sufficient to give a nominal 2000 candle power light, if that is the quantity called for. But we must also require that the carbons be honestly made and of a grade that will uniformly utilize the required current, and that the lamps are always in good condition and properly cared for. Some cities have discarded the candle-power standard, and now

call for the number of watts above mentioned. Upon this basis the only uncertainty is as to quantity of electricity, and as this can be easily ascertained there is little chance for dispute.

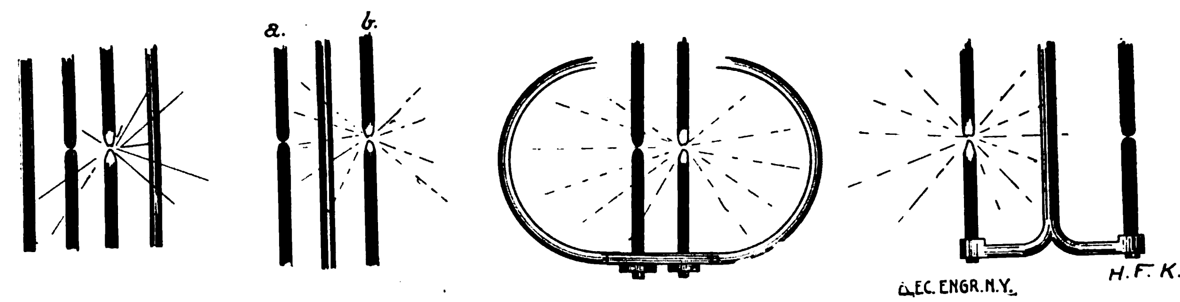
Defects in Arc-Lamps.—These have been hinted at above. Given a certain specified number of watts, delivered to each lamp, the amount of diffused light can be increased or diminished at will or by accident. For instance, a carbon can be so hard that the light will be very poor, but as the carbon burns a longer time there is an inducement for its use on the ground of economy. On the other hand a soft carbon will give the best light but soon burns away and thus is more expensive to the people who must pay for the carbons. Again, a carbon manufactured for use in a so called "2000 candle-power" lamp, if made of the density and texture that electricians require for such a capacity, will burn 6½ to 7 hours; but there may be an imperfection in the carbon which, if a soft place, will cause the light to burn out in less than 6½ hours, or if a hard place, will give less light but burn longer. Carelessness on the part of the trimmer, the man who puts the carbons in the lamps each day, is ofttimes a cause of poor light, for if the carbons are not set in a perfectly straight line with each other, the light is apt to go out. Again, the regulating of the "feeding" mechanism of the lamp has much to do with the degree of intensity of the diffused light. If the distance, or arc, between the upper and lower carbon exceeds 3 16ths of an inch, the light will, as the space enlarges, grow stronger, more fierce, and blaze up and go out, but this decreases the amount of diffused light. If the carbons touch each other the arc is closed and no light whatever is obtained. Thus we see that even the presence of the required standard amount of electricity does not prove that the proper amount of light is furnished.

Arc-lamp Shadows.—There is still another feature of arc-lighting which operates to diminish the amount of diffused light obtained from a given amount of electricity. The shadows cast by that part of the frame work of an arc lamp which supports the globe, is an objectionable feature in this style of street lighting. This part of the frame comprises the two side pieces that extend from the top, where they are joined to the upper part, to the bottom where they are fastened to and hold in position the lower portion. In the space formed by these two side pieces are fixed the carbons from which come the light. The framework thus stands between the light and the pavement and casts a more or less deep shadow on the street. In those lamps which have two sets of carbons the shadows are made blacker by the additional interposing of the extra carbons between the light and the street.

How shall we get rid of these shadows?—A lamp now being tried dispenses with the two side pieces of the frame work, and substitutes one centre piece which extends from top to bottom of the lamp, passing *between* the two sets of carbons, thus throwing a set of carbons on each side of one frame piece, instead of both sets being between two side pieces. These old and the new plans are illustrated by the accompanying engravings Figs. 2 and 3.

In practical operation Fig. 2 throws shadows on both sides of the lamp at all times, as above explained. In Fig 3 the shadow is never on both sides of the lamp at the same, but there is always a heavier shadow on either one or the other side. That is to say, the centre support of Fig. 3 is thicker and closer to the light than the side pieces in Fig. 2. As both these conditions tend to the intensifying of shadows, when carbon *b* is burning in Fig. 3 the shadow will be all on the left side, and be quite heavy, and when *a* is burning the shadow will be all on the right hand side.

The choice then lies between a constant shadow on both sides, of more or less intensity, or the concentration of all of the shadow upon one side at a time. Either is objectionable and must, and will, be remedied. And the remedy is not so hard to find. The shadows in both instances are intensified because of the close proximity of lamp frame work to the carbons. Hence if we remove the carbon away from the frame the problem is solved. If the frame in Fig. 2 were bowed out as in Fig. 4, or the frame in Fig. 3 shaped as in Fig. 5, the shadows would be very much less dense, and cease to be objectionable.



FIGS. 2, 3, 4 AND 5.—METHODS OF ARRANGING THE CARBONS IN ARC LAMPS.

A BLACKSMITH ASSOCIATION REPORT ON ELECTRIC WELDING.

At the annual convention of the National Railroad Blacksmiths' Association, in Pittsburg, a committee was appointed to investigate the subject of electric welding. The report of this committee, which has recently appeared says:—The Electric Forge Company, of Boston, is doing a variety of work which they claim to be doing economically, but as far as we have been able to learn are doing more drop forge work than welding. The Thomson Electric Welding Company is doing an endless variety of work, mostly of small dimensions; large work can be done, but it requires an enormous power, 90 horse power being required to weld a 2-inch square bar. It is used quite extensively for wagon and carriage work, which is light and can be very rapidly done. As near as we can learn, there are about twenty-five wagon and carriage manufacturers using the Thomson devices who are well satisfied with their results, and we are free to admit that a portion of the work can be better done than by older processes.

It is claimed that wire is welded together quite extensively where long lengths are desired; this would be difficult to do without it, especially when in bundles or coils; with it, it is simple and easy.

There are many things being done, or welds being made with electricity, that cannot be done (that is, practically done), by any other known process, such as welding steel rails together, of all sizes; and crossings of the same material, we are informed, have been fitted together; the several parts have been adjusted in position, the current applied, and its several parts welded together.

There is a class of work that we have been unable to get any authentic report of, that is, tube welding, a thing that cannot be satisfactorily or economically .performed by hand (or with what crude devices we may have) as compared with electricity. So all we may say in regard to it is taken from personal observation This work is being done quite extensively at Aurora, Ill., by the Hercules Iron Works, for welding tubes or pipe together to make coils for ice machines. They are tested at 500 lbs. pressure per square inch. In those there is no undue tensile strength required; these pipes are most of them bent into horizontal coils, which bend all right regardless of weld, there being no attention paid as to whether the weld comes in the bend or not; no trouble has been experienced on account of bad welds.

There is another process of electric welding that is not generally known, and is called the arc process, and, as devised by a Russian by the name of Bernardos, it is claimed that it can be used for a class of work that other processes are not adapted to, such as cracks in boilers, and other things where they are too complicated to be placed in or gotten to a machine. All the appliances that are necessary can be readily moved to where the object is to be treated. It is also said that a broken frame may by welded without being detached from the boiler.

THE ATLANTA EXPOSITION.

Mr. H. M. Atkinson, of the Georgia Electric Light Co. has submitted to the Atlanta Exposition management plans for an electrical plant of 1000 h. p., 500 arcs, and 10,000 incandescents.

UNIPOLAR INDUCTION.

ERNST LECHER in *Wiedemann's Annalen* discusses the different aspects of the question whether, when a cylindrical magnet rotates about its axis, the lines of force due to it are stationary, or rotate with the magnet. The former was Faraday's original view, the latter has been maintained by Tolver Preston and others. After showing that all the experiments hitherto quoted as decisive one way or the other may be equally well interpreted on either assumption, he describes some test experiments which show that the lines of force stand still while the magnet rotates.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Communications for the Editorial Department should reach it not later than Thursday. Copy for advertisements should be handed in not later than Friday.

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

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CONTENTS.

MUNICIPAL PUMPING FROM CENTRAL STATIONS.

THERE was a time when the central station manager took the greatest pride in pointing to the maximum ampere record of his station and strained every nerve to increase this particular showing. It is safe to say that no intelligent station manager now points to his maximum load, as such, with any degree of pride; on the contrary the presence of a high peak in the load curve indicates, as a rule, that there is still much work for the station to do which has been either entirely neglected or is slow to develop. The ideal station of the future will, indeed, be one having no maximum load, as we now know it, but in which a steady 24 hour run will show practically a uniform load line. The realization of this condition is making slow but certain headway, and as a result we find central stations doing work not contemplated a short while ago. We have already pointed out how in the Chicago Edison Stations the day load, for example, is brought up by the employment of motors for a variety of work until it represents nearly 40 per cent. of the station output. A like statement could be made with reference to the Edison stations in New York, where indeed in some districts the motor service is actually interfering with the lighting at some hours of the day. This condition of course obtains more particularly in populous centres, but the average station in medium towns has no large number of factories, elevators, etc., to run, and hence still finds its load factor a small one. Nevertheless we are of the opinion that the possibilities for increasing the earnings of such moderate plants have been by no means exhausted. The majority, if not all of such stations, depend practically for their very existence upon municipal lighting contracts, private lighting being in many cases but a secondary source of income. But there is no good reason why an electric station should not serve the municipality in other ways within its province, and one of the most promising of these methods appears to lie in the direction of pumping water for city purposes. We have already noted and illustrated such installations in the past, and in this issue add another to the list, that at DeKalb, Ill. In this instance, the city has very wisely left the entire control of the pumping station in the hands of the local electric company, which is paid a fixed sum for a given quantity of water raised to the reservoir or stand pipe level. The advantages of a pumping load upon a station plant are obvious. In the first place, whatever the extent of the load, it is absolutely uniform at that load. Then, again, where a given quantity of water is to be raised every 24 hours, the load may be distributed in connection with the lighting load of a station so as to give a practically uniform output line throughout the day. It may be argued that water works are usually situated at some distance from the distributing point, while the electric central station is, as a rule close to its centre of distribution. This very fact, however, is an argument in favor of the employment of electric power, which can readily be transmitted with minimum loss and which would obviate the necessity that now frequently exists of hauling fuel at large expense on heavy roads, to the remote pumping station. While the advantages to the central station of a continuous, steady load are obvious, the municipalty is like-

wise benefitted by the fact that such pumping can probably in the majority of cases be undertaken at less cost than it now involves, by means of steam pumps direct.

We believe it would be to the interest of every central station in smaller cities or in the country districts to consider this question of water pumping for municipalities; and that where ordinary pumping plants are in contemplation, a strong effort should be made to secure the work and thus save cities or companies the large sums now expended in laying down boiler and engine plants, which according to recent statistics are very costly to operate.

CONDITIONING THE COUNTRY TROLLEY.

One of the first ideas of those who had to meet the competition of country trolley roads was to crush them out of existence. One of the first ideas of those who were introducing country trolleys was that such systems were absolutely free from all the restrictions burdening older methods of locomotion and could be pushed anywhere without regard to consequences. It is needless to say that both parties have been cruelly disappointed. The trolley will not down, but before it can go much further it must be so conditioned that the public shall get the utmost good out of it with the least harm to life and property and the smallest sacrifice of some other things that make quite as much for joy and pleasure in this world as a five-cent car ride.

Among the first of the common sense rulings in the courts on the new questions involved is that by Judge Williams in the Supreme Court of Pennsylvania, of which we made note last week. He decided that street railway companies, as such, have not the right of eminent domain along country roads and highways. They may secure their city franchises from city and borough authorities, but township officers cannot, in granting the use of the public rural road, impose any such additional servitude upon private property for any uses other than those of the township itself and its resident population. In other words, as Judge Williams puts it, the existing laws did not anticipate the conversion of suburban roads into links of long lines of transportation between terminal points many miles apart; and he remarks: "It is not easy to see how such a company can protect itself in the use of country roads except by contract with every property owner along the roads it wishes to occupy." Of course many of these roads are in operation now, and cannot be interfered with, but new ones will be held back in Pennsylvania unless there is further permissive legislation.

That the laws will take cognizance of the new conditions there is little doubt, and we do not think that the legislation will be unfavorable to the just claims and rights of country trolley systems. The American public rarely cuts off its nose to spite its face, and it is aware that in many respects the country trolley is a distinct boon. But as it also knows that a trolley track can use up more than is to be spared of a good many roads, it is likely to insist either that the privilege of occupancy be paid for, or else that the company buy for itself a continuous slice closely paralleling the ordinary turnpike, so that the thoroughfare instead of being lessened for traffic is actually widened. The great advantage of the country trolley is that it does follow the highway and accommodates itself to the necessary sinuosities of long established and convenient routes. Coleridge has said that the road which rural people follow "winds round the cornfield and the hill of vines," and this is also one of the great merits of the trolley. It picks a man up where he lives and puts him down at the point he wants to reach, and what it does for his personal locomotion it is going to do also for his farm and garden produce.

ELECTRICITY ON THE BROOKLYN BRIDGE.

After long delays, the Brooklyn Bridge Trustees last Fall decided to introduce the electric light on the bridge cars. In this issue we give a complete, and the first accurate, description of the methods and apparatus adopted in the carrying out of this work. A slight consideration will show that the conditions encountered by Mr. J. H. Vail and his associates were as difficult as could well be imagined, and the successful accomplishment speaks much for the intelligence and fidelity of all concerned in this work. Now that the cars are lighted by electricity it would seem to be but a short and easy step towards operating them by electric motors. All the conditions are favorable for this, and with the overhead work now in position a trial of the method could be carried out with only slight expense. A beginning might be made by running an electric car instead of the steam locomotive now employed between the hours of 1 and 5 A. M., during which time the cable plant is shut down.

THE PATENT POOLING.

Officers and counsel of both Westinghouse and General Electric Companies still decline to affirm or deny the alleged agreement that has been so fruitful a source of gossip for more than a fortnight. It is reasonably certain, however, that the main points have been agreed to by both parties. The papers may still lack final signatures, and it is easy to perceive that the consummation of a contract so obviously complex and difficult must require a considerable period of time. For example, it is probable that the formal consent and approval of a number of inventors, now having agreements with either the General Electric or the Westinghouse company, must be procured before the pooling can be called complete. Doubtless such consents can be obtained in most if not all instances.

Apparently the agreement will permit both companies to use all patents of the other, subject to royalties to be paid to each other on a basis to be determined by a board of experts, the rates and amounts due to be determined quarterly. Wall street people seem to think that this plan will result in a saving in law expenses sufficient to pay a dividend of 2 or 3 per cent. on the common stock of the respective companies. Perhaps the annual reports of the two companies will throw some light on that "snap shot" estimate.

This arrangement will affect not only the companies' rights under existing patents, but future patents. Large sums of money have been spent thus far in the effort to determine the rights of the respective companies to certain old patents, but new patents, more especially the group known as the Tesla polyphase patents, are considered the most important of all. They form the basis for the arrangement now to be entered into. It is stated that this combination has nothing to do with the corporate rights and powers of the two companies; they will remain separate and independent as heretofore; there will be no Trust or consolidation of the companies, and no division of territory.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE GRANT FLEXIBLE CONDUIT RAILWAY SYSTEM.

Numerous attempts have been made to solve the problem of producing an electric railway conduit by enclosing the live conductor in a separate casing and tapping it at successive points as the car passes along the track. The most recent example of this arrangement is that embodied in a patent just issued to Mr. Harry C. Grant, of this city.

In this system the conductor is inclosed in a steel spring casing. This casing being water tight, and thoroughly insulated from all conductors, provides them with a protection from dirt, water and the moisture of the atmosphere.

In the accompanying drawings, Fig. 1 is a transverse section of an underground conduit system equipped in this manner, showing one of the girders which are placed at intervals along the road, supporting the rails, and the conduit C. The plates D D, which inclose the top of the conduit are somewhat wider than those of the cable, and removable, to insure easy access to the casing at any point.

At the bottom of the conduit is secured a beam E, which extends the entire length of the road, with the exceptions of spaces in the man-holes, and is provided with guide pins *e e*, to prevent the casing from shifting.

The casing which this beam supports is made in sections entirely independent of each other, with their ends closed water-tight and of such a length that they will reach fron man-hole to man-hole, leaving a space of about eighteen inches between them. This space is left in order to make room for tables, which support the joints of the conductor rail, H.

The conductor G, is mounted firmly on an insulated strip F, at the bottom of the casing. The wire is fed in the same manner as the overhead trolley, the connections passing through the ends of the casing in such a way as to make the joint water-tight and thus prevent any short circuit or leakage.

On top of the casing is a conductor rail H which extends the entire length, and is divided into sections one foot long, so as not to impair the elasticity of the casing. These sections are insulated from the casing and from each other, but electrically connected with contact pieces *h* inside the casing, which are directly over the conductor G. There are two of these points to every section of the conductor rail, and they are also insulated from the casing.

The end sections of the conductor rail are made long enough

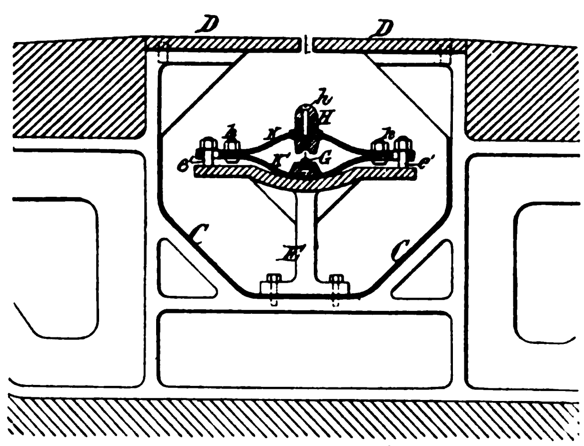


FIG. 1.—THE GRANT RAILWAY CONDUIT SYSTEM.—TRANSVERSE SECTION.

so that they may each reach half way across the spaces in the manholes previously spoken of, and meet on spring tables, the tops of which are insulated from the bodies to guard against a short circuit occuring at any of these points. These tables are provided with stops to prevent them from being depressed a greater distance than the casing.

The car is provided with a suitable contact piece, or trolley, such, for instance, as indicated by the dotted line at T, Fig. 2, consisting of a frame and two contact wheels connected with the car circuit. These wheels are placed a little farther apart than the length of one section of the conductor rail, to prevent them both from resting on the insulation between the sections at the same time and thus breaking the circuit for the instant.

As the trolley of each car passes along, the casing is depressed until the contact points H, at that place are brought into connection with the conductor G, the casing yielding in the same manner as the elliptical spring of a vehicle, and then returning to its natural shape as the pressure is removed.

On account of the style of the spring, and as it is coated with

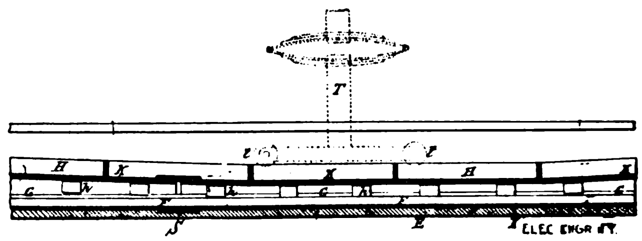


FIG. 2.—THE GRANT RAILWAY CONDUIT SYSTEM.—LONGITUDINAL SECTION.

a weather-resisting material the casing should prove of great durability. The main advantage claimed for the system is its thorough insulation of all conductors, even though the conduit be filled with water.

THE NEW YORK CENTRAL TROLLEY SECTION AT NIAGARA.

H. Walter Webb, third Vice-President of the Central, says of the proposed use of electricity on the Buffalo and Niagara Falls section :—

"It will be an electric branch before long. We are surprised that we did not think of the idea before, and are still more surprised to find how cheaply we can make the change. Our tracks up there are not in use all of the time, and it will be possible to run frequent trains at a high rate of speed, to accommodate local traffic, in a way that would be impossible on a steam railroad. The power to operate our trains can be obtained from the Niagara Falls Power Company, in which some of us are heavily interested. Special cars of the observation pattern will probably be built, so as to give passengers a fine view of the river and falls.

"The present plan contemplates a trolley system of such power that the improved coaches can be drawn over the line at the same rate of speed as at present. The fares will be reduced, and the comfort will be far greater, as there will be no cinders, smoke, and other inconveniences of a steam railway. We hope to have the road ready when the excursion season opens, at the latest, as there is little to be done in making the change."

POSTAL TROLLEYS IN PHILADELPHIA.

The news that white postal cars are to be built and operated as complete railway mail cars on the People's Traction electric lines between Chestnut Hill and Snyder avenue, in Philadelphia, has been officially confirmed by the receipt of the Postmaster General's approval from Washington. Ten sub-stations and all their contiguous territory will thus enjoy an expedited delivery of mails.

The Post Office authorities are preparing a printed scheme of distribution to be worked by the distributing clerks in transit on the trolley cars. Ordinarily the railway mail service distributes letters to the stations only; but it is intended on this line that the clerks shall distribute the mail to the letter carriers' routes of each district affected. This scheme contemplates the memorizing by the clerks of very many items of distribution of the mail for the letter carriers' routes, in order to further expedite delivery.

ELECTRIC TRACTION WORK NEAR DUBLIN, IRELAND.

Operations have begun for the construction of the new trolley road of the Dublin United Tramways Co. from Haddington Road to Dalkey. About $500,000 is to be spent on this and other sections. The work is under the supervision of Mr. J. Clifton Robinson, electrical engineer and managing director of the company, and Mr. Mossop, who represents the contractors, the British Thomson-Houston Co. Ltd. The power house is to be located at Balls Bridge. The cars are to be double deckers, and the motor cars will each haul a trailer. There will be 20 motor cars to start with. An average speed of 8 miles an hour will be made. The overhead system is to be carried by steel poles placed along the

curbstones on each side of the street, at distances of 125 feet apart. The line is the first to be built in Ireland under the Board of Trade regulations.

A TROLLEY LAUNCH AT MIDDLETOWN, N. Y.

The electric launch on the Wallkill river, at Midway Park, Middletown, N. Y., is to obtain its power this year from a trolley circuit. A wire will be strung over the river, and will be attached to a feed wire. There is no reason why this simple method should not be very successful, and lead to the introduction of other trolley boats on narrow streams.

ELECTRIC PLEASURE LAUNCHES FOR PHILADELPHIA.

The Philadelphia Traction Company is making arrangements with a view to securing palace cars for "trolley parties" during the summer. They will be leased to parties for the evening. Arrangements will also be made to serve luncheon on board the cars. Music will be furnished. It is also proposed to have electric launches placed in the waters of the Spring Gardens, in the vicinity of Long bridge, and the waters at Fort McHenry and the mouth of the Patapsco.

AN ELECTRIC ELEVATED FREIGHT ROAD BETWEEN NEW YORK AND CHICAGO.

The Inter-ocean Electric Railway Company, incorporated at Springfield, Ill., purposes to make some decided changes in the present method of freight transportation. The company has a capital stock of $200,000,000, the largest ever incorporated in the West, and several Chicago, New York, and San Francisco capitalists are said to be interested in the corporation. The intention is to construct an elevated electric freight railway between Chicago and New York for the transportation of coal and grain. The plans and specifications have been drawn by a Chicago engineer, and the company will own a number of patents on electrical devices used by the road.

The capital stock is divided into 2,000,000 shares of $100 each. The principal office is in Chicago, and the Commissioners to open books of subscription to the capital stock are James G. Hulse, Parker Crittenden, and John W. Hill, all of Chicago. The duration of the corporation is ninety-nine years. The modest projectors intend, they say, to extend the road later on from Chicago to San Francisco.

SALE OF STAMFORD, CONN. STREET CAR SYSTEM.

Directly following the announcement that the Consolidated Railroad Company was about to purchase the Norwalk Tramway Company, the Westport and Saugatuck Horse Railroad, and the Westport and Southport Tramway, comes the news of the actual sale of the Stamford Street Railway plant and franchises. The railroad was really purchased about a year ago by persons who are interested in the Norwalk Tramway and other Connecticut street railways. The new owners are a syndicate composed of J. Pierpont Morgan, E. C. Benedict, H. O. Havemeyer and others.

It is said that the entire street railway system of Stamford will be equipped with electricity.

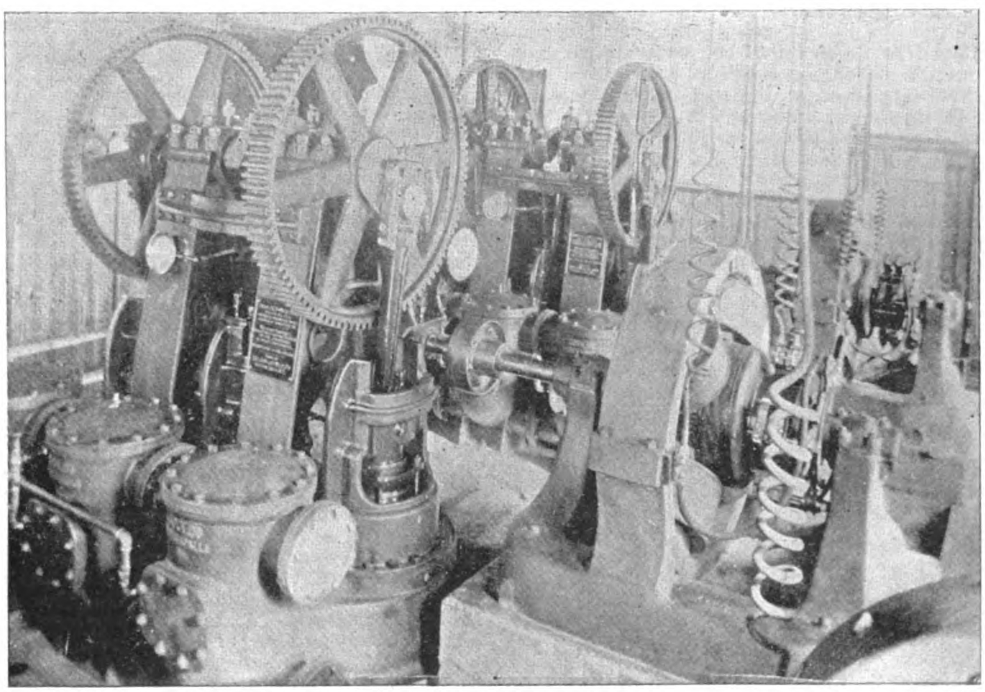
ELECTRIC PUMPING STATION AT DE KALB, ILL

THE accompanying engraving illustrates an electrical pumping plant for domestic and fire service, which has been installed a tDe Kalb, Ill., by The Goulds Co., of Chicago. The installation consists of a ten-inch drilled well from which the water is pumped by a deep-well pump driven by 30 H. P. electric motor. The water from this pump discharges into a reservoir near the pumping station, and from which it is pumped into the mains by two 10" x 12" Goulds Triplex pumps, operated by electric motors. The mains are so laid that what water is not consumed during the time of pumping is carried to a stand pipe from which it flows to the mains again when the pumps are idle.

The pumps are of the Triplex pattern, having three pistons ten inches in diameter, with twelve-inch stroke and directly connected to a 70 H. P. multipolar slow speed motor with rawhide pinions. At 48 strokes per minute, the capacity of each pump is 500 gallons. For the domestic service the pumps work against a pressure of 60 lbs., but being designed for fire service, are capable of working against a pressure of 125 lbs. An automatic device for closing the stand pipe connections from the mains is used in case of fire. As the capacity of these pumps is far in excess of the needs of domestic duty, they are used on alternate days and in this manner both pumps are kept in good working condition. In case of fire one or both pumps may be employed having a combined capacity of 1,000 gallons, working against a pressure of 125 lbs.

The current to operate the motors to drive the pumps is furnished by the De Kalb Electric Co., being carried from the power station to the pumping station, a distance of 2,000 ft. Five feeders are used and three feed wires, non-interference being insured by the use of two pole lines. This arrangement of wiring gives complete control of the motors, thus rendering it possible to start and stop them at a moment's notice. This plant is of such construction that there is under quick control an ample supply of water for all purposes.

In the contract between the City of De Kalb and the De Kalb Electric Co., the latter assume all care and attention of the machinery in consideration of a price of 4 cents for 1,000 gallons of water pumped. This contract is advantageous to the city in many ways, but especially in that the city has to assume no responsibility of the expense or maintenance of the plant. The Electric Co., on its part, has a plant which does the work required in a satisfactory manner both from the practical and commercial standpoints.



A GOULDS ELECTRIC PUMPING PLANT AT DEKALB, ILL

TELEPHONY.

THE HAYES AND SPENCER TELEPHONE SWITCHBOARD.

THE rapid and continuous increase in the number of subscribers connected to telephone exchanges has been followed by increasing difficulties in the rapid handling of connections. The multiple switchboard has been carried to a high state of perfection, but in large exchanges even that marvel of ingenuity has been found to have its shortcomings. Where calls follow one another in rapid succession, only a comparatively small number of subscribers can be handled by one operator. Thus in New York one girl handles less than 50 on an average, and even then is taxed at times beyond her capacity.

The operator's work is divided essentially in (1) answering the call, (2) making the connection, (3) ringing up, and (4) disconnecting, together with a number of intermediate functions, such as testing, etc. If, therefore, this work could be subdivided so as to leave each operator free to do a certain part of the work to the best advantage, leaving to another, another part of the work, time would be gained and better service afforded. It is with the latter idea in view that Messrs. Hammond V. Hayes and Theodore Spencer, of the American Bell Telephone Co., have designed the interesting switchboard illustrated in the accompanying engravings, Fig. 1 being a sectional and Fig. 2 a plan view.

As will be seen, the board has two horizontal working faces or keyboards and an intermediate vertical operating face, worked by the attendants who perform the operations which belong to the front horizontal working face. By means of this form, the advantages belonging both to the vertical and horizontal face types of switchboard can be combined; and in addition to a full force of operators stationed at the front of the switchboard, to perform such necessary duties of call-answering, and connection and disconnection-making, as are arranged to be performed by the appliances on the front keyboard, and the intermediate vertical face, a second force may be employed, stationed at the rear keyboard to perform the remaining portions of each connection and disconnection, and to ring up the second party to such connection.

The operators stationed at the front of the switchboard may for brevity and distinction be characterized as A operators. In like manner the operators stationed at the rear position may be termed Z operators. In operation, when any Z operator is notified by any A operator, that a connection is desired with a line represented at her table, she knows at once which trunks are free, by observing which of the trunk plugs are not inserted in any line spring jack, and she thereupon names the number of some one trunk which is at liberty, instructing the A operator in question, to connect the calling line therewith. By thus allowing the second part of the connection to be made by a second or trunk operator, and by causing that operator to nominate the trunk which is to be used, the work of the central office is materially expedited, because the initiatory operator is spared the labor and time of testing the several trunk sockets terminating at her board, until she finds one which is free.

The plug terminals of the several trunks rest on the rear horizontal face of the section in front of the Z operators, and are shown as being arranged behind the subscribers, line spring jacks or plug sockets. The second or Z operator sends the outgoing

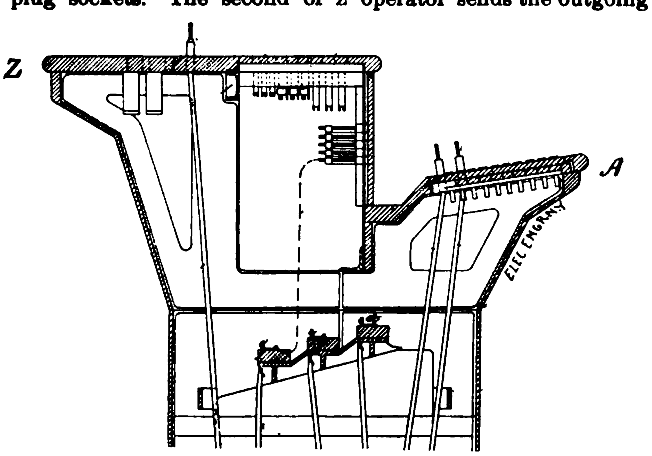


FIG. 1.—HAYES AND SPENCER TELEPHONE SWITCHBOARD.

calls for the line wanted, or for either of two connected lines, and accordingly is provided with ringing keys for that purpose, which are mounted on the rear horizontal section, and arranged near the rear edge.

The communications which at the beginning of a connection are exchanged between the A and Z operators concerned, are transmitted by means of an instruction circuit, and the instruction circuit to each Z operator, extends to the station of all of the A operators, and is at each section controlled by a key.

By this arrangement an extremely simple signaling system, requiring no extra or auxiliary circuits, is sufficient for all com-

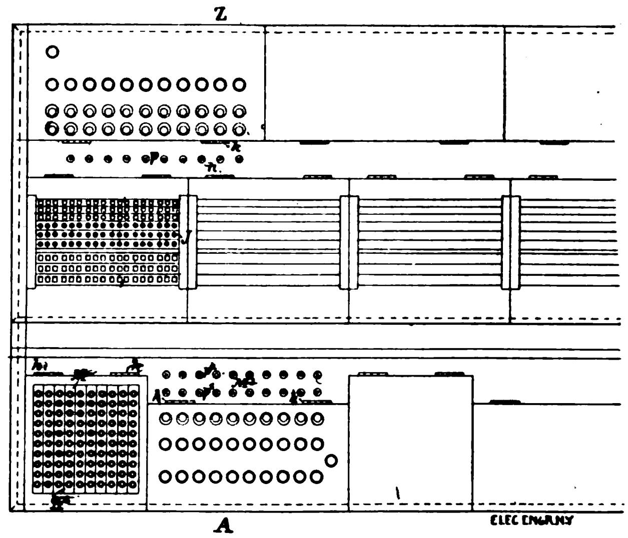


FIG. 2.—HAYES AND SPENCER TELEPHONE SWITCHBOARD.

munication between the two operators concerned in the manipulations of each connection, or between either operator and the subscriber; the only additional element in such communication being the employment of the telephone and the instruction circuit while the original order is being given and acted upon.

THE NEW YORK STATE TELEPHONE RATE BILL.

THE final hearing on the Gerst-Persons bill to reduce telephone rates in New York State was held at Albany on Tuesday April 2. Counsel for the Troy company stated that the bill would give his company rates ranging from $27 to $36 whereas the average operating expenses are $51 per station. He also argued that the bill had been drawn with complete ignorance of the telephone business as conducted in the smaller towns and that the working provisions were unjust and ridiculous. Mr. A. B Boardman, of counsel for the Metropolitan Telephone Co., made the closing argument against the bill. He pointed out the weak position occupied by the friends of the bill in that they had no support at all outside of New York, Brooklyn and Buffalo, although the bill applied to the whole state. Even in those cities the amount of support was trivial as in spite of circulars and appeals without number no petition from subscribers had been presented in favor of the bill. The endeavor had been made to overawe the committee by the factitious support of self-constituted bodies with high-sounding names. As the representatives of these bodies did not represent a preponderance, or even a respectable minority of the subscribers Mr. Boardman held that they had no standing before the committee as nobody but the telephone companies and the subscribers were interested in the question. The companies certainly did not demand legislation and the burden of proof lay on the supporters of the bill to show that the subscribers, in sufficient number to claim attention, did. This they had utterly failed to show. For instance during five hearings held at Albany not a single Albany subscriber had appeared in favor of the bill, although the friends of the bill had made every effort to arouse the interest of Albany subscribers. Mr. Boardman pointed out that in comparison with the rates obtaining in other cities and towns throughout the United States the present rates in New York State were fair and reasonable, whereas the bill dictated rates that ranged from one-third to one-half the rates in other places of equal size. A great deal had been made by Mr. Sterne, the author of the bill, of comparisons with European cities. Mr. Boardman showed that Mr. Sterne's data was erroneous at all points, and he supplied the committee with official statements and figures in proof of his remarks. Mr. Sterne was compelled to withdraw various of his previous statements regarding foreign systems. Mr. Boardman urged that in any case such comparisons proved nothing as the foreign systems operate under radically different conditions from those that obtain here and in most cases are administered by the Government without regard to commercial considerations. He held that the Committee could not regard the bill seriously when it had been shown by every company affected that the rates named were far below the actual operating expenses. In concluding he argued that the bill was vicious legislation and against

public policy in that it involved the delegation of legislative powers to a commission.

Mr. Sterne replied to Mr. Boardman but made little effort to meet the arguments raised against the bill, confining himself to general attacks on the policy of the telephone companies, particularly on that of the Metropolitan Company. He thought it was the duty of the Legislature to dictate rates even though no subscriber had complained. He suggested that the proper reply of the telephone companies would be to show their books, and intimated that nothing else put forward by them could be believed.

A young man from Yonkers followed Mr. Sterne with some curious and fantastic figures relating to the cost of telephone systems. He placed the cost of a complete system for 400 subscribers at $12,800, and he said the engineer who supplied him with those figures had estimated the average cost of operating in New York City to be $29 per telephone!

The bill now rests in the hands of the committee.

ORGANIZATION OF THE STANDARD TELEPHONE CO.

The Standard Telephone Co., president Thurlow Weed Barnes, with its headquarters at 68 Broad street, this city, has announced its appearance in the field of competition with a great flourish of newspaper trumpets. It has a list of ten territorial sub companies already formed and of nine more shortly to be added. The parent company has a capital of $10,000,000 and the sub companies have about $80,000,000. The names of nearly all the millionaires in the country are cited as being interested It is said that the company has some 25 patents, and those of Allen T. Nye and W. R Cole, are specifically mentioned. Mr. Nye is a prominent Wall street promoter, and is not known as an inventor. Mr. Cole has certain patents on telephones, which appear to relate chiefly to detail devices. No. 386,965 of July 31, 1888, is on a transmitter; No. 351,250, Oct. 19, 1886, is on a transmitter; No. 352,735, Oct. 19, 1886, on a receiving telephone; No. 352,806, Nov. 16, 1886, on a microphone.

TELEPHONE LITIGATION—AM. BELL CO. VS. GOODWIN, BYRNES & PRENDERGAST.

Judge Lacombe, in the United States Circuit Court in the action of the American Bell Telephone Company, et al., against Thomas Goodwin, Edward Byrnes and Patrick Prendergast for an accounting before a master to compute damages and costs, has granted an order on motion of the complainants terminating all proceedings under an order of reference for an accounting before a master, and releasing the defendants from all claims of the complainants for damages and profits on account of an alleged infringement of complainants' patents.

TELEPHONE vs. TROLLEY IN MONTREAL.

The Bell Telephone Company have begun suit against the Montreal Street Railway Company for alleged damages to their system. Evidence is being taken. The telephone company claim that upon the establishment of the single trolley system by the Montreal Street Railway Company in the autumn of 1892, many of the telephone wires were rendered unfit for use, owing to the operation of the grounded wires. Common return grounds had had to be laid, at a cost to the Bell Company, to date of action of $27,626.07, for which judgment is asked against the Street Railway Company, the Bell Company also reserving their rights to damages accrued subsequent to the institution of the action.

The Street Railway Company, in their plea to this action, give in detail their charter, and the amendments thereto, under which they operate an electric street railway in Montreal. Their charter was first obtained in 1861. It was amended from time to time. The last amendment, passed in 1886, gave the city of Montreal and the Montreal Street Railway Company the right to enter into any contracts or agreements with regard to the operation of a street railway in Montreal. In 1892 the company tendered for the franchise for an electric street railway and their tender was accepted.

They object to using a double trolley system which the telephone company suggests, and state that the latter company has no right to interfere with the use of the streets for travel.

A BIDDER 12 MILES AWAY.

A lawyer in New Jersey wishing to attend a sale of real estate went to Bridgeton, only to find that the sale was just beginning at Vineland, 12 miles away. Nothing daunted, he went to the telephone, put in his bid by its means and captured the property. Then he took the next train and signed the necessary papers.

ERIE, PA.—The new telephone company is now ready for business and the old one is reducing rates.

TELEPHONE NOTES.

ALTON, ILL.—Telephone rates are to be reduced here.

LAS VEGAS, N. M., is to have a new telephone system.

RINGGOLD, KY.—Ringgold is to have telephone connection with Chattanooga, Dalton and Chickamauga Park.

EMPORIA, KAS.—A new home telephone company has been organized.

ANDERSON, IND.—The City council has granted a franchise to the Harrison telephone company for a telephone service in this city.

LOUISIANA, MO.—The new telephone exchange here went into operation April 1.

JOHNSTOWN, PA.—The Johnstown Telephone Company is a newly chartered organization.

LINCOLN, ILL., is to build a telephone exchange and seek connection with the Lincoln Mutual.

DAKOTA CITY, DAK., will soon have telephone connection with Sioux City, Ia.

ALBURGH, VT.—A company has been formed to build a telephone line from Isle La Motte to Alburgh.

MARION, ALA.—Messrs. Wilkinson & Davis are establishing a telephone exchange.

ISHPEMING, MICH.—Anson B. Miner, Thomas Walters, Donald McVichie and George W. Hayden have been granted a franchise for the construction and maintenance of a telephone system.

CARTHAGE, MO.—The county court have decided to equip the new court house with a complete system of telephones so that every room can communicate with every other. Geo. Wheeler has been awarded the contract for putting in the system.

DEFIANCE, O.—The Northwestern Telephone company is the name of a new organization formed in this city. The incorporators are Kidder V. Haymaker, F. C. Pfander, Will Geiger, H. B. Tenzer, and John R. Wilhelm. The capital stock is $15,000.

FALL RIVER, MASS.—The Southeastern Massachusetts Telephone Company proposes putting up about the cities, where their exchanges are, public stations for the use of non-subscribers. It will be on the nickel-in-the-slot principle.

OMAHA, NEB.—The Nebraska Telephone company has reduced the price of telephone service in South Omaha. Heretofore the company has charged subscribers in South Omaha $5 per month for 'phones in business establishments and $4 for those in residences. The prices are now $4 and $3 per month.

BOONVILLE, N. Y.—Northern Herkimer county is to have a telephone line. In the Oneida county clerk's office have been filed articles of incorporation of the Fulton Chain Telephone and Telegraph Company, with a capital of $4,000. The directors are prominent citizens of Boonville and the towns through which the lines run. The home office will be at Boonville.

CONCORD, N. H.—The Concord & Montreal railroad is establishing a telephone system at the principal stations on its route, for the use of employés in facilitating the transaction of business. The Concord yard is now being equipped and the circuit will have twenty stations with the central office located in the train despatcher's office. The Manchester yard is now and has been for some time equipped with this system.

PHILADELPHIA, PA.—The *Philadelphia Press* announces that the Bell Telephone Co. will make the minimum charges in Philadelphia $50 a year against $120 now. The reduction applies only to telephones in the centre of the city. In some of the districts the saving to subscribers will be very material. Those who pay $50 a year will pay 5 cents a call after a certain number of calls allowed are exhausted.

WEYAUWEGA, WIS.—Clemens Schmidt, John Vogt, Joseph and A. W. Lautenbach, of Orihula; John A. Hildebrand, of Fremont, and E. H. Jones, W. H. Weed and A. L. Hutchinson of Weyauwega, have signed articles of incorporation for the Wolf River Telephone Company, to construct a line from this place to Orihula via Fremont, and to put in a local exchange in this place. The capital stock is $3,000, divided into sixty shares of $50 each. The officers elected are: Clemens Schmidt, president; Joseph Vogt, secretary, and A. L. Hutchinson, treasurer.

GRAND RAPIDS, MICH.—A Grand Rapids Syndicate has secured the Harrison telephone patents for Louisiana, Mississippi and Arkansas and will proceed to exploit the invention and establish local exchanges in that territory. For the sake of handling the work more effectively the syndicate has been merged into a corporation with a capital stock of $100,000, under the style of the Mississippi Valley Harrison Telephone Company. The officers of the corporation are as follows: President, Thomas Friant; vice-president and general manager, James D. Lacey; secretary, E. A. Stowe; treasurer, F. C. Miller.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 2, 1895.

Alarms and Signals:—

Electric Block Signal, F. P. Snow, Lynn, Mass., 536,764. Filed Apl. 27, 1894.

Electric Double Semaphore Block Signal, N. O. Goldsmith, Cincinnati, Ohio, 536,871. Filed Mch. 24, 1894.

Electric Block Signal, N. O. Goldsmith, Cincinnati, Ohio, 536,872. Filed Mch. 24, 1894.

Conductors, Conduits and Insulators:—

Terminal Attachment for Flexible Conductors, W. L. Richards, Malden, Mass., 536,655. Filed Sept. 10, 1894.

Consists of a terminal attachment and fastener whereby all strain is removed from the conductor.

Self Locking Cleat for Electric Wiring, F. O. Creager, Marseilles, Ill., 536,684. Filed Jan. 14, 1895.

Embodies a movable wedge which grips the wire.

Means for the Insulation of Conductors of Electricity, L. Dion, Natick, Mass., 536,857. Filed Dec. 6, 1894.

Claim 1: An insulation, for electric conductors, consisting of a waterproof sheath, a conductor arranged therein, and glass balls interposed in and filling the space between the sheath and conductor.

Distribution:—

Electrical Transformer, M. Dickerson, Fort Wayne, Ind., 536,608. Filed Nov. 26, 1894.

Each lamina of the core has only two magnetic air gaps together with a special method of breaking joints so as to decrease the magnetic reluctance.

Dynamo Driven from Axles of Railway Cars, W. Biddle, Brooklyn, N. Y., 536,748. Filed May 31, 1894.

Method of mounting and driving by means of ropes and grooved pulleys, so that the dynamo can be stopped when not in use.

Dynamos and Motors:—

Combined Dynamo Electric Generator and Current Director, J. F. McElroy Albany, N. Y., 536,816. Filed Jan. 2, 1892.

A governor is enclosed within the revolving armature and operates, by centrifugal force, movable iron bridges to decrease the magnetism of the field coils with the increase of speed, according to the requirements of the circuits.

Dynamo Electric Machine, J. F. McElroy, Albany, N. Y., 536,963. Filed July 24, 1894.

A disc armature composed of two semi-circular segments, each having generating windings crossing diametrically and returning peripherally, the two segments abutted, and an encircling clamping ring to form a rigid wheel.

Brush Holder for Dynamo Electric Machines and Motors, G. Valley, Cleveland, Ohio, 536,973. Filed Dec. 15, 1894.

Details of construction to increase the efficiency and length of life of the carbon brush.

Electro-Metallurgy:—

Electrolysis, H. Blumenberg, Jr., Mount Vernon, N. Y., 536,848. Filed Oct. 9, 1893.

Claim.—The herein described process, which consists in placing an electrolyte containing a haloid salt in a vat, electrolyzing the same setting free the halogen, under pressure, at the positive electrode and the base without pressure at the negative electrode, conveying the halogen to a closed gas-holder or accumulator, under pressure, conveying the base into a tank, and tapping the halogen in the gas-holder, when desired, and conveying the same to said tank where the product is formed.

Galvanic Batteries:—

Electric Battery, H. W. Libbey, Boston, Mass., 536,689. Filed Feb. 23, 1894.

Consists of a cell formed of one perforated positive and two perforated negative elements of disc form and separated by a slotted ring of insulating material and enclosed at each end by an insulating disc having a rim or flange projecting toward and holding the outer elements.

Lamps and Appurtenances:—

Socket for Incandescent Lamps, F. H. Soden, Chicago, Ill., 536,792. Filed Feb. 12, 1890.

The socket is designed for lamps placed in wet or damp situations; the shell is of porcelain.

Miscellaneous:—

Electrical Controlling System for Elevators, C. O. Mailloux, New York. 536,730. Filed Dec. 20, 1894.

Claim 1. The combination with the elevator and its starting mechanism of two controlling circuits or branches, one for causing the car to go up and the other down, an automatic switch at each landing actuated by the car for closing the one or the other branch or circuit according as the car is above or below said switch and adapted to stand in an intermediate position to break the circuit when the car is at the landing, and a manual circuit closing device or devices at each landing whereby either branch or circuit may be closed at will.

Type Writing Machine Attachment, C. Spiro, New York, 536,766. Filed Oct. 15, 1894.

An attachment to an ordinary typewriting machine, whereby symbols or signals may be produced or transmitted electrically, simultaneously with the printing of the letter or character corresponding to such symbol.

Electric Clock Winding Mechanism, M. V. B. Ethridge, Everett, Mass. & J. H. Eastman, Boston, Mass., 536,926. Filed Apl. 28, 1894.

Electric Organ Coupling Mechanism, E. S. Votey, Detroit, Mich., 536,974. Filed Apl. 7, 1894.

Electrically Controlled Magnet and Valve for Pipe Organs, E. S. Votey & W. D. Wood, Detroit, Mich., 536,975. Filed Apl. 7, 1894.

Electromagnet for Pipe Organs, E. S. Votey, W. B. Fleming & W. D. Wood, Detroit, Mich., 536,977. Filed Apl. 7, 1894.

Electropneumatic Stop Action for Pipe Organs, E. S. Votey, W. B. Fleming & W. D. Wood, Detroit, Mich., 536,978. Filed April 16, 1894.

Railways and Appliances:—

Electric Controller, G. Valley, Cleveland, Ohio, 536,794. Filed Dec. 3, 1894.

Details of construction.

Switch for Street Car Controllers, G. Valley, Cleveland, Ohio, 536,795. Filed Dec. 3, 1894.

The contact points are embedded in an insulating disc at different levels, with the spring contacts arranged around the discs to correspond to the different levels of the projecting contact points.

Contact Finger for Electric Controllers, S. Harris, Cleveland, Ohio, 536,808. Filed Dec. 5, 1894.

Claim 1.—A contact finger for electric controllers having the contact shoe rigidly affixed to an endless spring which is free to flex in any direction and is rigidly affixed to a carrying piece.

Supply System for Electric Railways, A. C. Crehore, Ithaca, N. Y., 536,838. Filed July 22, 1893.

A conduit system with sectional conductor in which the trolley preserves connection in passing from one section to another, and switch operating magnets continuously energized when the switch is closed, from the main line over a circuit from an auxiliary conductor normally disconnected from the power line but in continuous connection therewith while the car is passing over its section of working conductor.

System of Electrical Propulsion for Railway Cars, L. Dion, Natick, Mass., 536,855. Filed June 14, 1894.

A flexible, auxiliary conductor, which is normally in continuous contact with the main conductor and is picked up, or lifted, by magnetic attraction and brought into electrical contact with the conducting cover of the conduit at a point beneath the car, the current being taken off the surface of the cover by suitable brushes.

Supply System for Electric Railways, J. M. Byron, New York, 536,915. Filed June 16, 1894.

Divides the trolley rail into insulated sections into which current is thrown by automatic switches.

Closed Conduit System for Electric Railways, E. D. Chaplin and L. Dion, Natick, Mass., 536,918. Filed June 14, 1894.

Employs an auxiliary conductor consisting of a series of strips, or filaments, having conductivity and susceptible to magnetic attraction, their ends being overlapped and connected by a slot in one and a tongue and cross-head on the other.

Safety Device for Electric Railways Having Sectional Conductors, L. Dion, Natick, Mass., 536,923. Filed June 14, 1894.

Provides an automatic signal, operated by electricity, which shall notify the motorman upon a car of the existence of a condition which would result in leaving one, or more, of the conducting plates through which the motor receives its current, in electrical communication with the high tension feeder, thereby causing such plate, or plates, to remain fully charged.

Conduit Electric Railway, T. C. Hughes and A. W. Adams, St. Louis, Mo., 536,952. Filed Feb. 12, 1894.

The conductor is divided into sections to which the car successively makes contact through the medium of a water tight switch box containing a snap switch.

Trolley Support for Electric Railway Cars, E. B. W. Reichel, Charlottenburg, Germany, 536,967. Filed Oct. 25, 1894.

A trolley base designed to afford uniform pressure and unbroken contact between trolley and wire and also to facilitate the automatic reversal of the trolley arm from one slanting position to that in the opposite direction.

Switches and Cut-Outs:—

Electric Mercurial Switch or Contact Maker, H. Lemp, Lynn, Mass., 536,811. Filed July 26, 1888.

Encloses in an exhaust receptacle, separate bodies of mercury and a core of a magnet constructed to act as a conductor between said bodies, and arranges a magnet in relation to said core that the latter may be lifted from or allowed to dip into the mercury.

Telegraphs:—

Electrical Switchboard, F. W. Jones, New York, 536,809. Filed Jan. 22, 1895.

Consists in arranging the line contacts and the instrument connections at right angles to each other upon a frame of insulating material, rendered fire-proof from suitable treatment, and insulating the line connections and the instrument connections from the frame by a suitable air space.

Telephones:—

Telephoning Apparatus, W. B. Robeson, Philadelphia, Pa., 536,705. Filed Sept. 7, 1894.

Embodies an alarm or indicator which operates when the receiver is not hung up.

Telephone, J. Serdinko, San Antonio, Texas, 536,763 Filed Dec. 4, 1894.

Details of construction of magneto transmitter and magneto call combination.

Telephone Exchange System and Apparatus, H. V. Hayes and T. Spencer, Cambridge, Mass., 536,787. Filed Sept. 10, 1894.

For description see page 334, this issue.

Telephone, F. H. Brown, Chicago, Ill., 536,914. Filed Oct. 17, 1894.

Claim 1: In a receiving telephone, the combination with the casing, and the diaphragm, of a permanent magnet, a pole of which lies adjacent to the diaphragm, and a permanent magnet located wholly within the casing remote from the other magnet, and having a small part of its surface in contact with the edge-surface of the diaphragm, so that the interior magnet is charged with the same polarity as the contacting pole of the other magnet.

Telephone System, F. R. Colvin, New York, 536,990. Filed Dec. 20, 1894.

The object is to provide a simple and effective exchange system for interconnecting a plurality of subscribers whose instruments are located in different circuits, and for operating the system by batteries or electric generators located only at the central station.

LEGAL NOTES.

MR EDISON FREE TO MAKE HIS OWN PHONOGRAPH.

It will be remembered by our readers that last November the American Graphophone Company, of Washington, D. C., owning the patents of Bell and Tainter covering the graphophone, sought to secure preliminary injunctions against users of Mr. Edison's phonograph, and that motions were argued before Judge Green at Trenton, and before Judge Lacombe in New York. These motions have recently been denied. The defendants contended that the success of the modern phonograph is due to certain remarkable discoveries made by Mr. Edison as to the recording of labial and sibilant sounds, and not to the suggestions contained in the Bell and Tainter patents, which are in themselves impracticable, and also that growing out of the contracts between the parties which were made at the time the North American Phonograph Company was organized by Mr. Jesse H. Lippincott, the phonograph is licensed under the graphophone patents. The defendants were represented by Messrs. R. N. Dyer and S. O. Edmonds of the well known firm of patent lawyers, Dyer & Driscoll.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE BILLINGS' DROP FORGED COMMUTATOR BARS, AND OVERHEAD LINE MATERIAL.

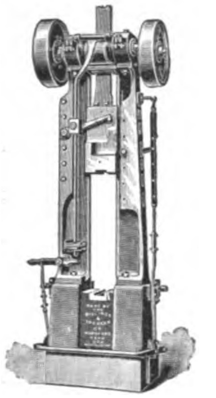


Fig. 2.

THE drop forged commutator segment known as the Billings' patent, was invented by Charles E. Billings, President of The Billings & Spencer Co., Hartford, Conn., manufacturers of machinist's tools and drop forgings. Commutator bars were made prior to November 6, 1888, the date of the Billings patent, of a single piece of brass, ordinary bronze or other electrically conductive alloy cast in specified forms. Bars were also made of two arms separately constructed and soldered, screwed or otherwise joined together. According to this method the main arm of the segment has sometimes been formed of rolled or drawn copper strips and the remaining arm, on account of the difficulty alluded to, has been formed of brass or other material cast in the desired form.

The object of Mr. Billings' invention was to produce a drop forged segment of pure copper and by so doing to avoid the disadvantages, both mechanical and electrical, which are involved in uniting two pieces of metal or in using other substances than unalloyed copper for the purpose of forming a commutator bar.

Fig. 1 A illustrates the preliminary operation of drop forging, showing a cylindrical copper rod shaped to the requisite length, heated to a malleable state. While in this condition it is subjected to the action of successive pairs of dies in a drop hammer. By the first pair of dies the so-called operation of "breaking down," the rod is ready for subsequent forging and bending of arms to the required shape to fit any special commutator.

Fig. 1 B shows the result of the "striking up" which produces a bar in an unfinished state to conform to the specified type. The bar is then treated with acid for the purpose of removing oxide. When cold, the flashed edges on the bar are trimmed in the usual manner and then the bars are subjected to a hardening process and each bar is tempered uniformly, thereby giving them all an even and durable wearing surface.

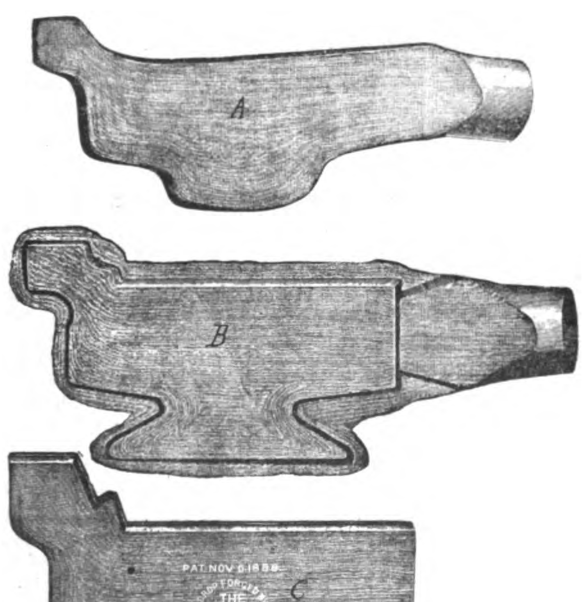


FIG. 1.—DROP FORGED COMMUTATOR BAR.

Fig. 1 C shows a finished bar ready for the No. 12 Westinghouse commutator. The most important feature of the bar lies in its being formed in one solid piece wrought from a single copper rod by the process of drop forging. It has the grain or fibre of the material always parallel to the outline of the commutator bar, no matter what shape the same may be bent to, and still be of one metal, homogeneous in molecular structure throughout and of great density, of uniform temper and conductivity. The engraving Fig. 2 shows the drop hammer employed for this work

The successful adaptation of drop forged material for electrical appliances has suggested the advantages of producing wrought metal as a substitute for ordinary brass castings in the manufacture and construction of overhead trolley equipment, using Colophite insulation, and the Billings and Spencer Co. have prepared a line which will be offered to the electric railways for Spring

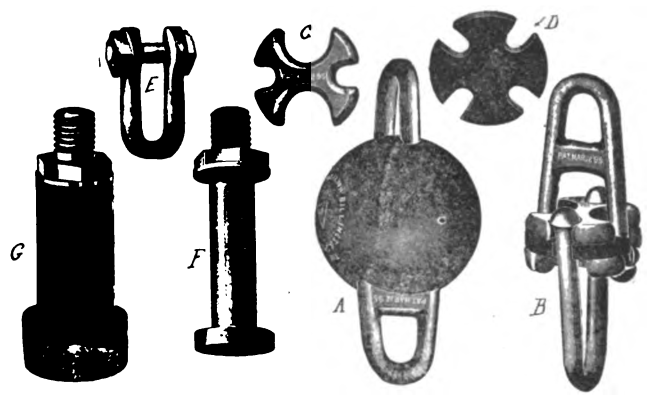


FIG. 3.—COLOPHITE OVERHEAD LINE MATERIAL.

renewals and extensions. A few of the fixtures are illustrated in Fig. 3.

The Colophite insulation used by the Billings & Spencer Co., is the invention of S. J. Hoggson, of the Colophite Mfg. Co., New Haven, Conn. The adhesive and elastic properties of "Colophite" are so great that it is particularly useful for an insulating compound subject to constant strains and vibrations, being unaffected by the atmosphere, and is a natural preservative, impervious to the climatic influences of oxygen, snow, ice and moisture.

In the engraving Fig. 3 A shows the Colophite insulated link strain or frog-pull-off of Tobin bronze or steel. The links shown at B are separated first by strain discs of bronze or steel C and

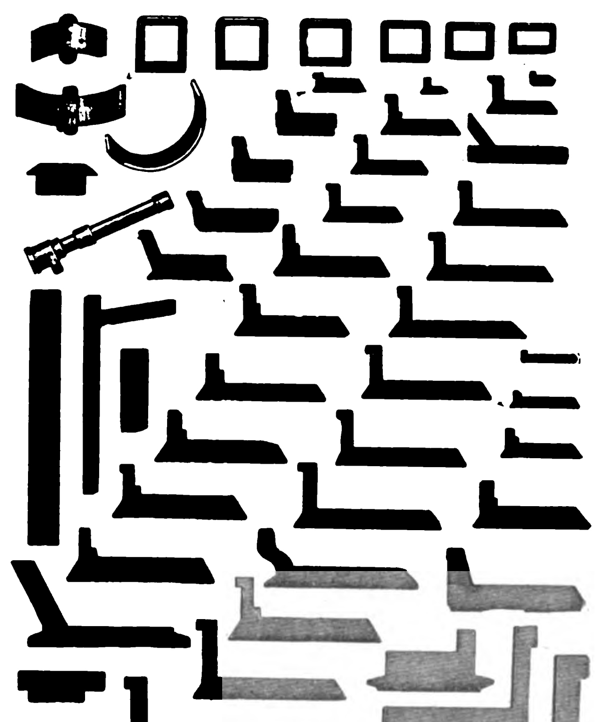


FIG. 4.—VARIETIES OF DROP FORGED COMMUTATOR SEGMENTS.

insulated from each other by a hard rubber disc shown at D, the whole being then covered with colophite in the shape of a sphere as shown at A.

A series of electrical tests have been made of the Colophite

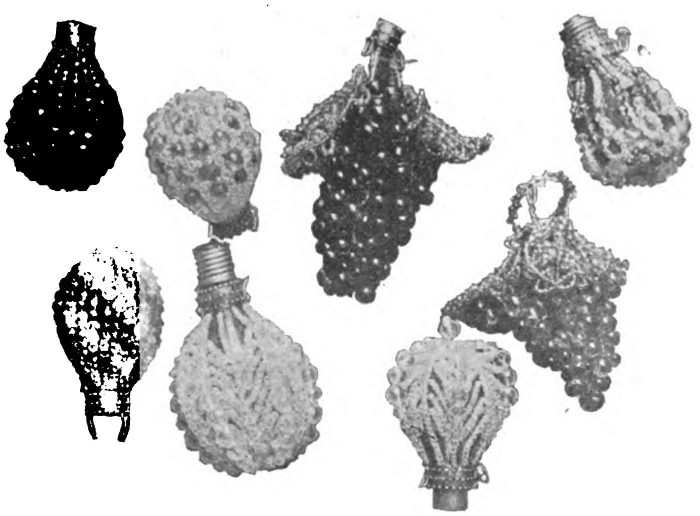
insulation of the drop forged link strains, showing a resistance of 200,000 megohms, guaranteed at 575 volts. The tensile strength of the steel and Tobin bronze was from 65,000 to 80,000 pounds to the square inch; crushing strength of centre disc, 12,000 pounds. This test was made by the Pope Mfg. Co., Hartford, Ct., on an Emery testing machine.

Among the other devices for railroad work we may note the interchangeable attachment for link strain to make a frog-pull-off, shown at E, Fig. 3, made of drop forged tobin bronze or steel, and the colophite insulated stud for straight line hanger shown at G and F. Fig. 4 shows a large variety of drop forged commutator segments made by the Billings & Spencer Company.

The Pettingell-Andrews Co., of Boston are the selling agents for the Billings & Spencer Co., and Mr. Frank X. Cicott who originated the idea of using drop forgings for overhead line material has charge of the company's railway department.

GLASS-BEAD SHADES FOR INCANDESCENTS.

The frosted incandescent lamp has always been in favor on account of the softness of its light and the obviation of the effect of the direct rays on the eye. The decoration of incandescent lamps has undergone a variety of changes, having in view the same object as frosting, and hence we may note the application in the past of paper in the form of flowers, silk shades, etc. These, however, have not found general favor for the reason that they either absorbed too much light, were gaudy, or charred so rapidly that every few days they had to be replaced. Perplexed at all the attempts to solve the problem of combining an appropriate shade for the electric light without destroying the elegance of the glass bulb, a lady, one of the best known leaders of society in Paris, attracted by the effect produced by the sun's rays playing on a Japanese cloth made of glass beads which hung at one of her



BEADED SHADES FOR INCANDESCENT LAMPS.

windows, solved the difficulty at once by taking the beaded cloth and wrapping it around an incandescent lamp; the effect was most pleasing. She called her electrician and ordered him to make a shade of glass beads in the shape of the lamp bulb, and fasten it as best he could.

The electrician, Mr. E. Vedovelli, succeeded in making the desired shade and completed it by the introduction of a clasp made of a circular ring of the lazy tong type. The shades thus finished were placed on the lamps and the effect produced was recognized to be all that could be desired. Several days after, the lady conquered Paris by the surprise she gave her guests with the new illumination of her salons, and the result was, that orders came from all over to the electrician, who, to fill these orders, had to give up his professional engagements to become the manufacturer of the glass beaded shade for incandescent lamps, now being rapidly introduced everywhere.

Our engraving shows a number of these shades or covers in various designs and colors, and which can be readily slipped on or taken off by the most inexperienced. These shades are exceedingly moderate in price and are now being introduced in the United States by Mr. Henry Guinard, of 446 Canal St., New York.

THE PACKARD ELECTRIC CO., LTD., C. C. Paige, manager, Montreal, inform us that they have acquired and will operate under their name the business heretofore carried on by the Dominion Electric Co., Ltd. and the Packard Lamp Co., Ltd.; assuming all obligations.

THE BRADY MFG. CO. OF BROOKLYN.

Mr. James Brady, the energetic manager of the Brady Mfg. Co., York & Washington streets, Brooklyn, has issued a pithy and pointed circular calling attention to the fact that they have been successfully engaged for thirty years in the design and manufacture of labor-saving machinery, besides giving much valuable help in this respect to inventors and manufacturers. They design and make drawings, patterns, special tools and fixtures—in fact furnish complete plants for anything made in metal on the interchangeable plan. They also make such goods in quantities on contract.

THE "ROYAL" APPARATUS IN THE EAST.

The important announcement is made that the Royal Electric Company, of Peoria, Ill., have completed arrangements with Messrs. H. B. Coho & Company, No. 203 Broadway, New York City, to handle their alternating current apparatus in the East.

Messrs. Coho & Company have secured the services of Mr. George C. Hoffman, formerly of the Westinghouse Company, who will have charge of their alternating current department.

THE EUREKA OIL PURIFIER.

The Eureka Oil Refiner Company, of 1020 Betz Building, Philadelphia, have introduced the Eureka double acting waste oil cleaner, purifier and storage tank, which, they claim, is the only double acting machine of its class. It is said to be practically indestructible. It contains no filtering material, but the oil is subjected to a gentle heat, causing it to deposit its sediment, after which it is washed by passing through water. It is claimed to save from 75 to 90 per cent. in oil bills.

A PALACE OF ELECTRICITY AT THE PARIS EXHIBITION.

At a dinner given in his honor by the Syndicat des Electriciens in Paris, recently, M. Alfred Picard, General Commissioner of the 1900 Exhibition, declared that a special palace was to be devoted to electricity, and that it would be one of the chief features of the exhibition.

MR. J. C. CALISCH.

THE FORT WAYNE ELECTRIC CORPORATION has opened an office at 761 Powers Building, Rochester, N. Y., in charge of Mr. J. C. Calisch, who will handle the territory of Western New York and Northern Pennsylvania. Mr. Calisch brings with him a large experience in the selling and installing of electrical apparatus and will without doubt make his influence felt in that district.

EXTENSION OF WESTINGHOUSE MACHINE WORKS.

The Westinghouse interests have arranged to extend their mammoth works, already spread out almost in a solid block from Brinton to Wilmerding, a distance of two miles, by the construction of a large shop for the use of the Westinghouse machine company. It will be constructed of brick and stone, and will be 602 feet long, 228 feet wide, and two stories high. The main structure will include the foundry, machine shop and warehouse. It is said that it will cost between $300,000 and $400,000. The boilers and heavy steam hammers will be in another new building connecting, which will be 60 x 200 feet, and of similar construction.

NEW POWER HOUSE OF THE NASSAU ELECTRIC CO.

The new power plant for the Nassau Electric Co., at South Brooklyn, N. Y., is fully completed. This building was designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn. The engine and dynamo room is 58 ft. wide and 150 ft. long, equipped with a 18 ton crane having a travel the full length of the building. This portion of the plant is covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof lining. The boiler room is 47 ft. in width and of the same length as the engine and dynamo room, and is so arranged that 2000 tons of coal can be stored in the pockets. The entire construction is of iron and the buildings, when completed, will be fire-proof.

WESTERN NOTES.

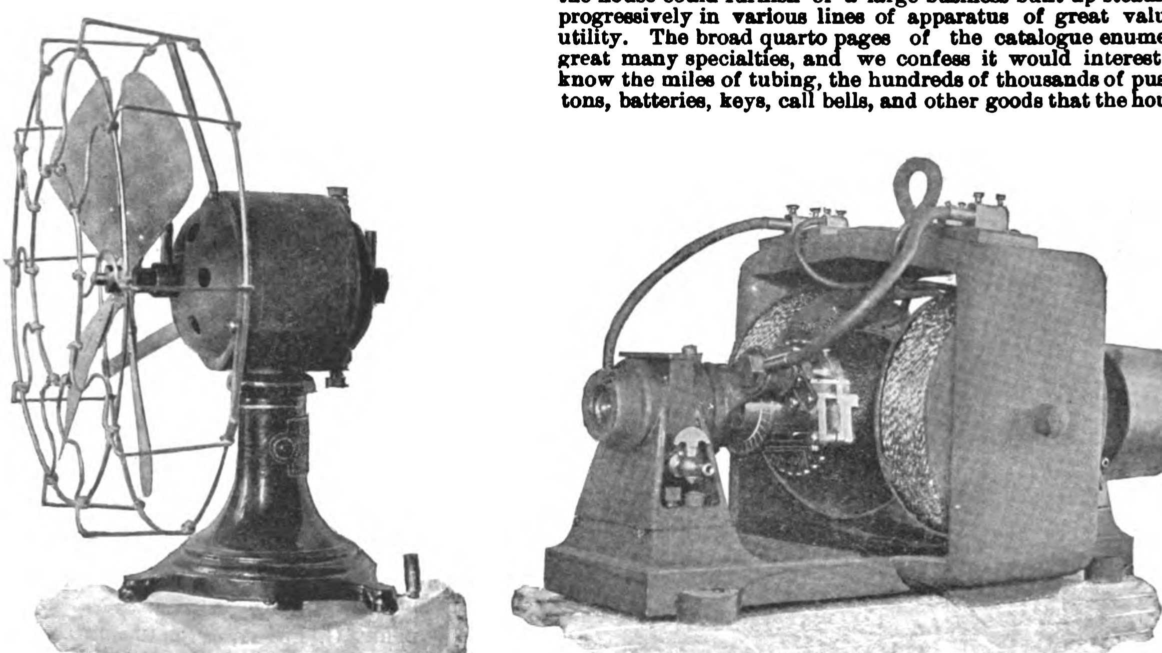
MORRIS & MACCURDY, of the Phœnix Rubber Insulating Paint, Indianapolis, Ind., write us:—We are meeting with flattering results from the users, in fact the testimonials being received are far beyond our expectations. We have just completed a large warehouse for manufacturing and carrying a stock and are now prepared to make shipments from 5 gallons to a car-load on twenty-four hours' notice.

THE NEW RIKER FAN AND BIPOLAR MACHINE.

THE fan motor which has been brought out this season by the Riker Electric Motor Co. emb odies several features of merit. The parts of the machine, which are interchangeable, are so arranged as to be easily accessible and yet protected from dust. The body of the machine is made of cast steel as in their larger machines, and the bearings and base are of cast iron. A resistance is enclosed with the base by means of which four speeds from 900 to 1800 revolutions may be attained.

The fan is a four blade and 12 inch, and at 1800 revolutions consumes ¼ ampere at 120 volts. As shown in the engraving Fig. 1, the fan is mounted in the usual manner with a wire guard, the entire apparatus presenting a neat and attractive appearance.

The new form of bipolar machines made by the Riker Company in sizes from ¼ to 7½ K. W. is shown in the illustration, Fig. 2. The armature is of the toothed core drum type with the core firmly keyed on the shaft, thus securing the direct driving of the armature coils. The armatures are insulated throughout with the best mica, and wound with double covered wire. The fram and base are of one steel casting, the magnet coils and cores bein cylindrical. The latter have horned pole pieces and are securely bolted to the frame. This construction with the low bearing centre employed gives an extremely rigid and reliable machine.



FIGS. 1 AND 2.—NEW RIKER FAN AND BIPOLAR MACHINE.

ELMER G. WILLYOUNG & CO.'S INSTRUMENT CATALOGUE.

THE catagogue of electrical and scientific instruments and apparatus manufactured and imported by Elmer G. Willyoung & Co., of Philadelphia, just issued, is a compilation which will prove a handy reference to all engaged in electrical work whether of a practical or scientific nature. The classification of the work renders the quest for any desired instrument a simple matter and the subdivisions, given below, will show its scope: Condensers, Electrometers, etc.; Galvanometers and their accessories; Resistance Standards, Resistance Boxes and Wheatstone Bridges; Keys; Magnetic Measurements; Photometry. To these are added various instruments of precision, such as chronographs, recording drums, clocks, cathetometers, etc. Special chapters are also devoted to Lord Kelvin's instruments of all kinds including his direct reading electric balances, electrostatic voltmeters, etc., and to the Weston standard instruments.

The special value of the catalogue lies in the fact that the instruments, besides being admirably illustrated by clear wood cuts are briefly but clearly described, and not infrequently references are given to works in which the apparatus is described in detail. Messrs. Willyoung & Co., besides manufacturing their own instruments, are sole American agents for Nalder Bros. & Co., London, and agents for James White, Glasgow, maker of Lord Kelvin's instruments, and L. Oerthug, London, maker of chemical, analytical and assay balances.

THE INTERNATIONAL INJECTOR.—A CORRECTION.

In an illustrated notice of The "International" Injector, manufactured by the World Specialty Company, of Detroit, Mich., printed in THE ELECTRICAL ENGINEER of March 20, 1895, we made an unfortunate error in describing it as the "International Penberthy Injector." The title of the article and caption of the illustration should have been merely "The International." The appellation "Penberthy" has no connection, we now learn, with the injector manufactured by the World Specialty Company.

PARTRICK & CARTER CO.'S NEW CATALOGUE.

Some branches of the electrical business are very large that one hardly ever sees noted. People take them as a matter of course and that is the end of it. It will be, for example, a matter of surprise to many electrical people who count themselves well informed, to learn that of patent needle annunciators alone, the Partrick & Carter Co., of Philadelphia, have put in over 80,000, in all parts of the world, in hotels, banks, offices, dwellings, etc. Yet anyone who looks at the handsome new catalogue just issued by this concern, must realize that this is but one instance that the house could furnish of a large business built up steadily and progressively in various lines of apparatus of great value and utility. The broad quarto pages of the catalogue enumerate a great many specialties, and we confess it would interest us to know the miles of tubing, the hundreds of thousands of push buttons, batteries, keys, call bells, and other goods that the house has disposed of since 1867. The field of these household and miscellaneous supplies is moreover a growing one, each year seeing many meritorious novelties brought out, and the Partrick & Carter Co. give evidence of their easy ability to keep abreast of each new demand, while retaining all the trade that has accreted to them in the last thirty years. Their handy, tasteful catalogue should enjoy a large circulation, and every one in anywise concerned with interior installation work ought to have a copy.

WESTERN NOTES.

THE BRADFORD BELTING COMPANY, whose goods have been heretofore handled by C. E. Woodruff & Co. has found it necessary to open a separate Chicago branch house, and has appointed Messrs. John Figel and A. Shillinglaw as Chicago managers. They are now putting in a complete stock of all sizes of the "Rivetless Monarch" belting, and will also carry a full line of electrical and fire alarm goods of latest and most approved make.

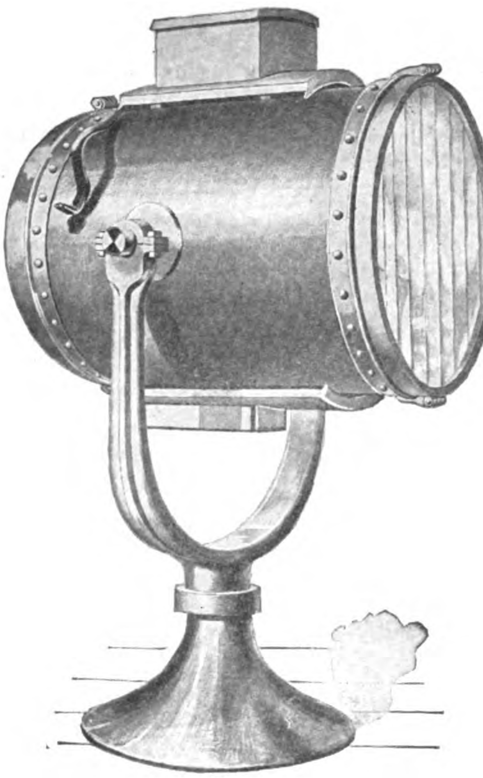
J. HOLT GATES reports the following sales of electrical apparatus for March: One 50 K. W. multipoler machine to Schwartzchild & Sulzberger Packing Co., Kansas City, Mo.; 250 H. P. in motors to the Bucyrus Steam Shovel & Dredge Co., South Milwaukee, Wis., for Montana; one 110 K. W., one 85 K. W. and one 60 K. W. multipolar machines for Pennsylvania; one 65 K W., direct-connected, with Ideal engine, to J. H. Garaghty, Columbus, Ohio; one 250-light machine to St. Paul, Minn.; one 100-light machine to Two Rivers, Wis.; two 15 K. W. machines to Arlington, Minn.; two 20 H. P. motors to Messrs. B. F. Sturtevant & Co., Chicago.

THE RUSHMORE AND HUNTINGTON SEARCH LIGHTS.

We illustrate herewith the Rushmore and Huntington search lights, which are now extensively used in all classes of land and marine service. Among the recent types of these lights is a lens mirror projector designed for large steamships and where a very powerful light is required, and is built in sizes from 15,000 to 40,000 candle power. Another is the standard pilot house light, and is specially designed for placing on top of the pilot house where it can be operated by the man at the wheel.

The accompanying engraving shows the standard plain light for smaller vessels where a cheap and powerful light is required.

These lamps, which are made by the Rushmore Dynamo Works, of Jersey City, who also make the well-known Huntington lights, are built to operate on any direct current of high or low voltage. The feeding mechanism is of liberal proportions and the feed is not affected by the position of the light, which will work continuously in a vertical position, as when used for flashing signals on



Rushmore and Huntington Search Light.

the sky at night. The construction is such that any ordinary mechanic can make repairs when required.

These lamps are now used also in conducting engineering works at night and a large number have recently been sold to electric railroads, which use them to attract crowds to places of amusement along their lines.

A RECEPTION BY THE EDISON ILLUMINATING CO. OF BROOKLYN.

On Wednesday, April 8, the Edison Electric Illuminating Co. issued invitations for an inspection of its First District Station in Pearl Street, Brooklyn. The response was hearty, indicating the interest the public has in the workings of electricity. In the hall on the third floor of the building, leading from the elevator to the general offices, was placed an exhibit of the applications of electricity such as the use of curling irons, chafing dishes, flat irons, coffee pots, tea kettles, stoves, heaters, and a pump operated by a Lundell motor. In the lecture room in the building the A. B. See Company had an exhibit of their electric elevator and just opposite them was a switchboard carrying a complete line of central station instruments manufactured by the Brooklyn Electric Mfg. Co. Other exhibits in this room were those of the Monarch Electro-Medical Cabinet which attracted considerable attention as did also that of J. C. Vetter & Co. who had on hand a full line of surgical instruments operated by a small motor. Then, there were sewing machines, a kitchen where good things to eat were given away, and a piano played by an electric motor. These exhibits were made to show the layman the uses to which electricity may be put in the home. In the private offices some wonderfully pretty work was observed in the way of decorative lighting and some miniature colored lamps were not without effect. The meter and testing rooms were well attended during the evening.

Going downstairs and passing through the gallery containing the switchboard, the visitors came to the dynamo room. A description of this was published in The Electrical Engineer, February 28, 1894. The guests witnessed the running of the machinery of the "booster" system, and marvelled at the 33,750-lb. electric crane of the Morgan Engineering Co. The De La Vergne cold storage system was also to be seen and an electric forging process was in operation. There was an exemplification of street lighting, shown by underground conduit carrying the three-wire system and automatic street lamps.

The evening was a pleasant one, and not a little of its success must be attributed to the numerous guides who courteously delivered lectures to inquirers on various topics of applied electricity.

THE PACKARD LAMP IN NEW YORK.

With a view to the better supply of this section of the country with the well-known Packard lamp, a New York office of its manufacturers, the New York & Ohio Co. has been established at No. 1 Broadway. The office is under the management of Mr. J. W. Peale, the president of the company, and we understand that Mr. H. M. Willson will be actively associated with it. The new lamp will be pushed vigorously. The makers claim for the lamp that for several hundred hours it shows an increased efficiency and a gain in candle power over the initial. This can be easily proved by buying some. All inquiries and orders will have high voltage attention.

FIRE AT THE CROCKER-WHEELER FACTORY.

We note with deep regret as we go to press the destruction of the Crocker-Wheeler Electric Co.'s factory, at Ampere, by fire. The total loss is put at $200,000. The property was fully insured. It is said that about $50,000 worth of motors and dynamos were going through the shops at the time. The Company will resume work at once, and will rebuild. The office building was fortunately saved and with it the drawings and patterns. Part of the main machine shop was also saved. Most damage was done in the winding and shipping departments. The fire broke out on Sunday afternoon after some men had been cleaning up the shops.

WESTERN NOTES.

The Brownell Car Co. of St. Louis issue some very clever circulars showing the great utility of their "door-at-the-step" cars, which accelerate travel by allowing all passengers to get on and off easily—a thing quite impossible with the old style car when its central door is blocked.

Mr. Godfrey G. Luthy, of the Royal Electric Co., of Peoria, Ill., has just returned after a two weeks' sojourn in New York during which he concluded arrangements for the handling of his company's apparatus in the East by Messrs. H. B. Coho & Co. Mr. Luthy reports that the increasing demand for the Royal Co.'s apparatus has made necessary an increase of the company's manufacturing facilities and they expect to move into larger and more commodious quarters at an early date.

Metropolitan Electric Company have been appointed Agents for the Solar arc lamp for incandescent circuits. It has been found to be a most thoroughly economical and practical lamp. It is simple in construction, has a positive action of feed, with no springs or dash pot, and no see-sawing. The lamp is manufactured plain or in various styles of ornamentation to meet the reqirements. Samples are being exhibited at the warerooms of the Metropolitan Electric Company, 186 & 188 Fifth Avenue, Chicago, where they carry a stock for immediate shipment. Prices are made to suit the times.

The Heine Safety Boiler Company, St. Louis, Mo., thinks that its orders during the last week in March are significant of an improved business situation. The widespread nature of the business is a good sign, and the character of the trade itself is very complimentary to the Heine boiler. During that week the Heine Co. closed contracts for both the street railway plants of New Orleans, which machinery men have been working on for so many months past; St. Charles St. R. R. Co., three boilers 615 H. P.; The Orleans R. R. Co., two boilers 510 H. P.; R. H. White & Co., Boston's big dry goods house, three boilers, 610 H. P.; the Equitable Building, Denver's finest structure, three boilers 750 H. P., to replace another type; New Planter's Hotel, St. Louis, one boiler 200 H. P.; De Lamar's Gold Mining Co., De Lamar, Nevada, one boiler 120 H. P.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XIX. APRIL 17, 1895. No. 363.

ELECTRICAL ENTERPRISE IN CALIFORNIA.—THE LOS ANGELES ELECTRIC COMPANY.

BY

George Heli Guy.

IF all the prominent cities of this country were canvassed as to their possibilities in the matter of relative increase in population during the next ten years, the beautiful Los Angeles, Southern California, would probably come out at the head of the list. Its balmy climate attracts every year from many countries a large contingent of invalids, of whom not a few are enabled to renew their health and strength, and become useful members of society in what frequently proves to be their adopted country. Much, too, of the energy of the overcrowded East is gravitating naturally to this "Chicago of California," as it has been called, which has within its borders the makings of a mighty city. It is the natural centre of the surrounding country, and two transcontinental railways, the Santa Fé and the Southern Pacific, make it their headquarters. The faith of the citizens in the future of this southern metropolis is unbounded, and this confidence is refreshing at a time when depression of a more or less pronounced order still pervades so many of the business communities of the country. During the last ten years the population has increased from 40,000 to 80,000, and nearly all branches of commerce are prospering.

Specially noticeable is the advance in electrical work, and more particularly in electric lighting, and The Los Angeles Electric Company has made a record in rapid progress that few cities can equal. The company was organized in 1881 by the late George H. Roe, who held the Brush rights

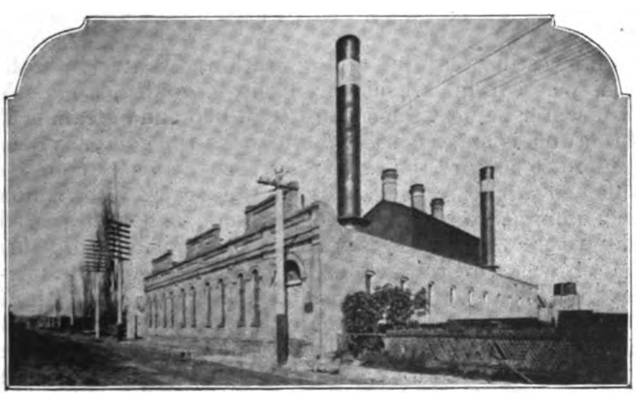


FIG. 1.—LOS ANGELES, CAL., ELECTRIC LIGHT STATION.

for the Pacific Coast. The city had advertised for lighting bids. Those were experimental days, but, nothing daunted, the contract was applied for, and secured, and the installation of the electric light was promptly taken in hand. It is barely twelve years since the opening night of the service. The people from far and near flocked into the town to see its illumination by the "new-fangled" light. The little station was inundated with visitors, and Mr. J. W. Warren, who held the fort that night as he still does, was beset with such questions as: "Where is the hole in the wire that the juice comes through," and a thousand more of the inquiries that add to the ruggedness of the pioneer's way. The feature of the display

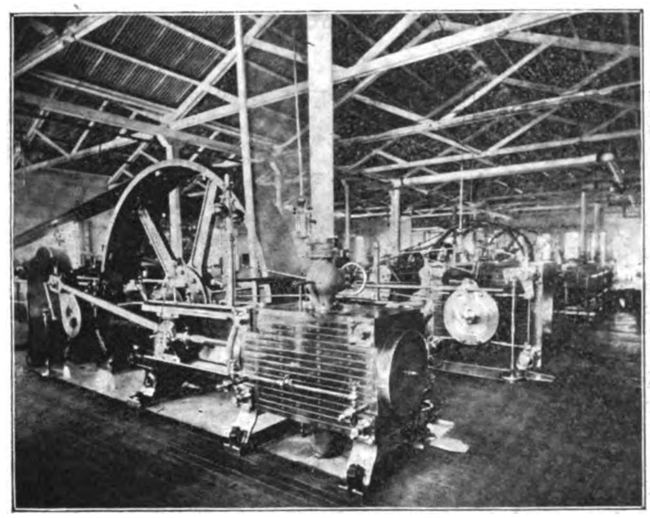


FIG. 2.—HAMILTON-CORLISS ENGINES, LOS ANGELES ELECTRIC LIGHT STATION.

was the series of masts, surmounted by clusters of 3 arc lamps, that were put up about the streets and squares of the city; and although there was some disappointment that the moon was not turned to darkness by the brilliance of the illumination, according to the general expectation, the people went away satisfied, as they had, at all events, seen the "'lectric light." Moreover, they liked it, and an enactment was shortly afterwards passed by the municipal authorities that the gas posts which had been left standing pending the result of the experiment, should be taken down; and Los Angeles blossomed out into the distinction of being the first city in America that was lighted entirely by electricity.

The first station was built in the centre of an old vineyard, on a spot which is now the corner of Banning and Alameda streets, and covered with buildings. In laying the foundation the workmen had much extra labor in clearing away the roots of the vines; but they evened up matters by feasting on the grapes which still bore plentifully all around the site of the building. The plain, but substantial station, which was but 50 feet by 50, had a modest enough start. The generating plant was included in two Brush No. 8 machines, of the old type of armature; one of these, a 3,000 C. P., was used for city lighting, the other, a 2,000 C. P., for commercial service. They were driven by two 50 H. P. high speed engines, made by the Fulton Engine Works, of San Francisco. The success of the city contract work, which comprised the lighting of seven masts, 150 feet high, each mast carrying three 3,000 C. P. arc lamps, was so pronounced that the entire output of the plant was immediately taken up. Six months after,

the company put in a 100 H. P. Myers cut-off engine, which drove two more Brush No. 8 machines. The debris left by the workmen had hardly been cleared away before it was found necessary to provide more power. This was done by enlarging the station, increasing the generating plant by two more Brush machines, and adding a 200 H. P. Corliss engine, with corresponding boiler capacity. About this time, the company entrusted to Mr. Warren an investigation into the merits of crude petroleum as fuel. The result of the tests was satisfactory, and the company decided on the regular use of oil instead of coal. They were the first in California to adopt the new fuel, which they did in the face of many forebodings of failure.

In 1893 the Company moved into their present building, at the corner of Alameda and Palmetto streets, on a lot of land 130 by 300 feet. The station, which is illustrated in the accompanying engraving, Fig. 1, has a frontage of 100 feet and is 130 feet deep, and the capacious yard gives ample room for all extensions that are likely to be required for some time to come.

The Brush system is used for the arc circuits, and the incandescents are operated by the Westinghouse alternating system. The total length of the circuits, which in 1882 was 6 miles, is now 120 miles. The main part of the service is supplied by overhead conductors. There are 18 arc circuits and 5 incandescent mains. The station is located 6,000 feet from the centre of distribution. Its present capacity is nine hundred and sixty 2,000 C. P. arc lamps, and seven thousand 16 C. P. incandescents. They are principally on the meter service, the Shallenberger meter being used.

The boiler room has a battery of eight 100 H. P. horizontal tubular boilers, four of which were made by the Brownell Company, of Dayton, O., and four by the Phœnix Iron Works, of Meadville, Pa.; and three 200 H. P. porcupine boilers, making a total boiler capacity of 1,400 H. P.

The engine room has one 500 H. P. twin compound Hamilton-Corliss engine; high pressure cylinder, 18 inches diameter; low pressure, 34 inches; stroke 42 inches, running with 125 pounds pressure at 86 revolutions per minute, and shown in Fig. 2. At this speed one horse-power is developed with not more than 17 pounds of water per hour. The driving wheel, which is 16 feet diameter, is grooved for fourteen 1½ inch ropes. By means of these ropes the power is transmitted to countershafting; this rope transmission has given most satisfactory results, both in regard to efficiency and economy, and is preferred to leather belting.

There are also three 200 H. P. Corliss simple condensing engines, cylinder 18 inches, stroke 42 inches, 85 revolutions per minute. Each of these engines drives four No. 8 Brush dynamos in tandem, making a compact and efficient installation. There is in addition one 200 H. P. Allis-Corliss twin compound, cylinder 16 x 24 inches; and one 100 H. P. tandem compound condensing high speed engine, made by the Phoenix Iron Works, Meadville, Pa. Three of the Corliss engines are provided with Wheeler surface condensers, and one with a 200 H. P. surface condenser made by the Fulton Engine Works, of San Francisco, Cal., making a total cooling surface of 2,700 square feet.

The water for condensing purposes is taken from the "zanja," or irrigation system, which distributes water from the Los Angeles River through different portions of the country south of the city. This ingenious utilization of water primarily intended for irrigation is one of the most interesting features of the station. Water in California, where rains are usually light, is golden, a miner's inch of water being valued there at $1,000; and steam coal at $10 a ton is an expensive luxury; so the company was fortunate to acquire the right to divert the water from its channel to a long reservoir within the works, from which it was pumped through the condensers, and then passed back into the zanjas. It was found that not only did this entail no waste of water, but that the raising of the temperature of the water increased markedly the growth of the fruits and vegetables in the irrigation area, which was thus more effectually served than it would have been by the normal cold water supply. The station has also a system of cooling pans, into which, in case of a temporary failure of the zanja supply, the water from the condensers is pumped. After being exposed to the atmosphere, the water is returned to the tank cool enough to be used over again. It goes into the pans at 150 deg. Fahr. and reaches the tank at 80 deg.

The electric generating plant, Fig. 3, now consists of sixteen No. 8 Brush dynamos; a Westinghouse 120 K. W. automatic regulating, compound wound, alternating cur-

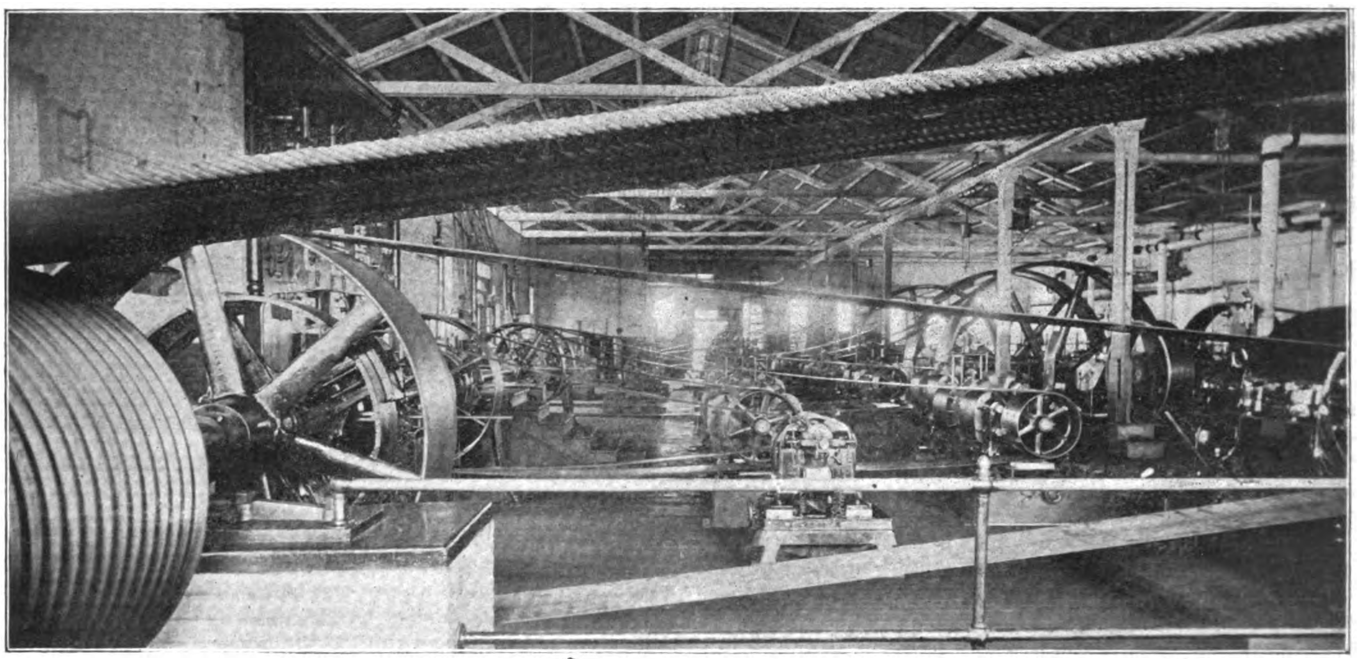


FIG. 3.—DYNAMO ROOM, LOS ANGELES ELECTRIC LIGHT STATION.

rent generator; one National system 120 K. W. generator; one Westinghouse 60 K. W., compound wound, alternating generator; and an additional Westinghouse 240 K. W. alternating current generator is just being installed. On the alternating current circuits excellent results are obtained by banking a number of transformers along the principal streets, which gives a system as flexible as that of the direct current, and free from the ordinary troubles.

Mr. W. B. Cline, the president of the company, was formerly identified with the lighting industry in San Francisco, in connection with the Pacific Gas Improvement Co. He took the active management of the Los Angeles Electric Co. four years ago, and has succeeded in making for the company a financial record second to none. Mr. W. R. Blackman, the secretary, has been closely associated with the company for many years.

Mr. J. W. Warren, the superintendent of the station, was the first man to switch on an electric light in the streets of Los Angeles. A pioneer in electric lighting in California, he has gone through the storm and the stress of the Western development of a new industry. Living "at the tail end of creation," where manufacturers were not, neither supply houses, an electric light station superintendent had often but little else than brains wherewith to meet "bugs" and "trouble," and Mr. Warren's stories of the shifts he has been put to in building up the electric lighting service of Los Angeles would fill a volume.

CLASSIFICATION AND SELECTION OF LIGHTING SYSTEMS.—II.

(*Concluded.*)

BY

Francis B. Crocker

The Selection of a System.—The classification given in the preceding article may be tabulated in the following form from which the choice of an electric lighting system must be made.

CLASSES.	SYSTEMS.
Central Stations.	1. Incandescent. / Arc.
	2. Direct. / Alternating.
Isolated Plants.	3. High tension. / Low tension.

The actual selection of a certain system and type of apparatus for a particular case depends of course largely upon the peculiar circumstances that may exist, and the greatest care should be exercised in taking into consideration the local conditions which, rather than general principles, usually determine the success or failure of an electric lighting plant. The safest guide is, of course, *experience*, and the engineer, if he does not himself possess the experience should, if possible, find some case where the conditions resemble those with which he has to deal. By a careful study of the results obtained in the case selected as an example, one can often get the benefit of much experience which will save time and trouble, eliminate mistakes and obtain results that would not otherwise be possible.

It is foolish for an engineer to launch out without regard to the experience obtained by others at great cost in similar cases, on account of conceit or false pride which makes him unwilling to profit by results already obtained. Many a partial or total failure would have been prevented by a little more carefulness and common sense in this direction. It is almost always a mistake for an engineer to employ some untried method or apparatus solely upon his own knowledge and responsibility, unless it is absolutely necessary, or unless those who have to pay for the experiment understand the facts of the case; and when the engineer goes so far as to try his own inventions (in regard to which he is of course prejudiced) at the expense of others, it is positively dishonest. A certain amount of experiment and novelty is a necessary element of each engineering problem and this contributes to general improvement and progress, but experiments should usually be tried as such, and all persons interested should realize that one is being tried; in fact the proper place for engineering experiments is in the experimental department of some company or institution. Nothing is more important or interesting than experiment, and the world would stand still without it; but in practical and regular work it is usually found that the simplest, most standard and well-tried devices give by far the most satisfactory results. Radical and sensational departures from established practice are usually the cause of regret to all concerned.

The Size of Plant.—This the engineer must definitely know before making any exact plans or calculations. It is usually ascertained in terms of the number and distances of lamps that will be required, by making a thorough canvass of the city or town or that portion of it which it is intended to light. The probable number of lamps which the station will supply when it first starts up, and what the number is likely to become afterward are matters upon which the entire design and construction of the station depend.

Let us consider the simplest case first and assume that the plant to be installed is an isolated one for lighting one building or group of buildings. In this case there is little or no uncertainty, and the low-tension, direct-current, constant-potential system would naturally be selected. Since the distances and lengths of wire required would be small, there would be no reason for using a high-tension system of any sort. During the last few years the utility and scope of this system has been greatly extended by the fact that many forms of arc lamp have been devised which work admirably upon constant potential circuits, being, if anything, better than constant current arc lamps. These are run, two in series, on the ordinary 110 volt circuit with a small amount of resistance in series with them.

This possibility of running both arc and incandescent lamps on the same circuit avoids the necessity of putting in special constant current machines to run the arc lamps, which was formerly done even in the case of isolated plants and involved considerable extra first cost and much more trouble in running the plant. Arc lamps operated in this way on a low tension circuit are limited in regard to distance from the generator just as in the case of low tension incandescent lamps, but it has occurred to the writer that since a certain amount of resistance is needed in series with constant potential arc lamps, it would be perfectly possible to use the wires leading to the lamp for that resistance, thereby avoiding the necessity of a special resistance in the lamp and at the same time permitting the lamp to be placed at a considerable distance from the generator.

The possibility of using other systems for isolated plants is rarely considered, but is by no means out of the question. It would be perfectly feasible to operate a low tension incandescent system by means of an alternating current dynamo generating, say, 110 volts. Of course no transformers would be required in this case, and there would be the apparent advantage of avoiding the commutator of a direct current dynamo, but the commutator of the exciter is fully as objectionable; in fact there would be two machines to take care of instead of one. Several plants installed by J. E. H. Gordon and others for incandescent lighting were operated by low-tension alternating currents. But those early systems were rather crude, and since the direct-current system of incandescent lighting was perfected by Edison, low-tension alternating systems have been rarely used in electric lighting. The objection to these systems besides the one already stated is the fact that up to the present time it

has not been possible to operate motors very satisfactorily with the simple alternating current, and that would be a fatal objection for isolated plants in which motors are frequently used, particularly in this country. In short, the low-tension direct current is very satisfactory for ordinary isolated plants, since arc and incandescent lamps, motors, dynamotors, electric heating, electro-metallurgical apparatus and storage batteries can all be operated perfectly in connection with it.

When isolated plants become very large, as for example in the case of a number of factories or other buildings scattered along some distance apart, it then becomes practically the same question as selecting a system for a central station, there being, as already stated in the beginning of this chapter, no absolute dividing line between the two. The selection of the best system for a central station is the most serious problem that the electrical engineer is called upon to solve, and having once decided, it is almost impossible to change. If the business of the station is to be confined to arc lighting for streets, the regular constant-current arc system would naturally be adopted. There are a number of stations of this kind in this country, the business of which is entirely, or largely, arc lighting. In such a case there would formerly have been little question, but Fifth Avenue in New York City is now lighted by arc lamps on the low-tension (230 volt, 3 wire) system, and the alternating current system is being used in St. Louis and other cities for supplying arc lamps by means of constant current transformers. The Westinghouse Company also have a series system for supplying alternating current arc lamps.

Alternating vs. Direct-Current.—If the average distances of the lamps from the station are not very great, the low-tension direct-current system is very satisfactory for arc lamps, particularly if incandescent lamps are also supplied. But a large station usually does a general business including arc and incandescent lighting and power distribution to various distances from the station, and the problem then becomes very complicated.

This brings us face to face with the much-discussed question of high-tension alternating versus low-tension direct current, concerning which there are radical differences of opinion among the best authorities. In both America and Europe, the greater number of incandescent lamps are now operated by the low-tension direct-current system; hence custom sanctions its use. But allowance should be made for the fact that the alternating current has not been so long in general use. The only reason for using high voltage alternating or other currents in electric lighting or power transmission is to reduce the cost of the conductors required. The cross-section of wire needed to convey a given amount of electrical energy in watts, with a given percentage of "drop" or loss of potential in volts, is inversely proportional to the square of the E. M. F. employed. In other words, it only requires a wire of one quarter of the cross-section and weight, if the voltage be made twice as great; hence the great economy in conductors secured by the use of high-tension currents. This advantage can be realized either in saving the weight of wire required or in transmitting the current to a great distance with the same weight of copper.

In comparing and deciding between the alternating and the direct current systems there is a tendency to think only of the cost of the copper conductors and to forget the cost of transformers, greater complication and positive danger to human life, all of which ought to be counted against the high tension alternating system. Furthermore, an electric light plant usually runs a large part of the time lightly loaded, and during all that time the alternating system is much more wasteful of energy than the direct, because in the former case the leakage current is always flowing in the transformers, whereas in a direct current system the loss of energy in the distribution system is extremely small at light load, since it varies as the square of the current. If the distances of the lamps are very great—several miles for example—then, however, there is little or no question, and an alternating current system with transformers would almost necessarily be adopted. Formerly, in this country, the potential was almost always 1000 volts; but now 2000 volts or even more are frequently used, which still further extends the distance at which lamps can be economically operated. By the use of potentials of 10,000 to 20,000 volts obtained by "step-up" transformers or directly from the alternator, the possible distance may become 20 to 50 miles, or even more. If on the other hand the population is fairly large and dense so that a sufficient number of customers can be found within about 1½ miles of the station, then, for the reasons stated above, a low-tension direct system is usually more satisfactory.

The limit of distance at which the alternating system is preferable to the direct cannot be fixed exactly, since it depends upon so many factors, one of which, for example, is *the value of human life.* Prof. J. A. Fleming states that the economical limits are reached in the two-wire direct-current system (about 110 volts), "when the mean length of the feeders is some 300 or 400 yards," and in the three-wire system (about 220 volts), "when the mean length of the feeders is from half to three-quarters of a mile" (The Alternating Current Transformer, Vol. II, p. 337). With a mean length of feeder of ¾ mile, lamps can be fed at a distance of 1½ miles from the station which makes it possible to supply a circular district three miles in diameter, if the station is at the centre; if it is not at the centre the available district will be correspondingly smaller. Other parts of the city can be lighted by other central stations or by sub-stations. It is also possible by certain methods to considerably extend the economical limit of distance. One plan is to generate a higher electrical pressure at the station to supply those lamps which are remote, that is, the feeders running to the most distant parts of the district are operated at a higer voltage than the others. This higher pressure is produced by special dynamos or more conveniently by small auxiliary dynamos called "boosters" which raise the voltage in certain feeders. Methods of this sort have been very successfully applied by the Edison Electric Illuminating Company of Brooklyn, and in other places, and lamps are successfully operated at a distance of two or three miles from the station.

The low-pressure direct current system should generally be selected for any case in which the station can be located in or near the district to be lighted. In support of this statement we may refer to the fact that the stock of the companies operating low-pressure systems in New York, Brooklyn, Boston, Chicago, Philadelphia and many other cities was quoted on April 15th, 1893, at prices which averaged about 150, the lowest being 110 and the highest 220. Even during the extraordinary financial depression in July, 1893, these stocks did not fall any more than the best railroad securities. These are considerably higher than the stock of corresponding companies employing the high-pressure alternating or arc systems, and this is a much more positive proof of the success of the low-pressure systems than any abstract argument. Similar statements apply to European stations also.

If the station must be located at a distance of several miles from the district to be lighted as, for example, when a water power is to be utilized, then it is practically necessary to adopt the high-pressure alternating system, and many fine stations of this kind exist throughout America and Europe. The alternating system would also be more economical and suitable, where the houses of a town are very much scattered or stretched out in a long line or where two or more neighboring towns are to be lighted from one station.

The International Pacific Cable Company, which failed to get a national charter from Congress, will go ahead with its project of connecting San Francisco, Honolulu and Yokohama by cable, and will act under a State charter.

A GRAPHICAL METHOD FOR FINDING RESISTANCE OF DIVIDED CIRCUITS.

BY

W. E. Wines.

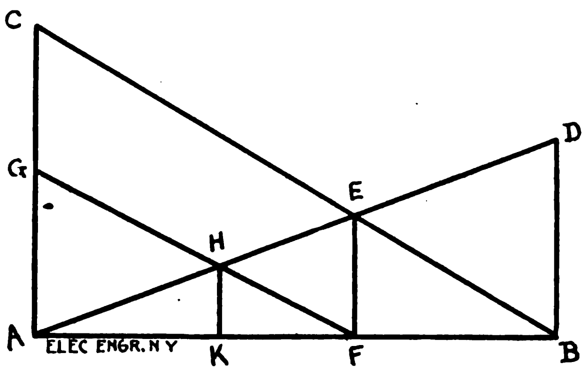
The following is a simple method for obtaining graphically the combined resistance of any number of resistances joined in multiple. Suppose for example that it is required to find the resistance of a circuit composed of two branches whose resistances r_1 and r_2 are known. Draw a line A B of any convenient length, and at A erect a perpendicular A C equal, on any suitable scale to B_1. At B erect another perpendicular equal, on the same scale, to r_2. Join A D and B C and from their intersection E draw E F perpendicular to A B. Then E F equals the resistance required.

The truth of this result may be readily proved by proportions resulting from the similarity of the triangles. Putting E F equal to x.

$$\frac{x}{r_1} = \frac{FB}{AF + FB};\ \frac{x}{r_2} = \frac{AF}{AF + FB};$$

$$\frac{x}{r_1} + \frac{x}{r_2} = \frac{AF + FB}{AF + FB} = 1\text{ ; and } x = \frac{r_1\, r_2}{r_1 + r_2}$$ which is the well-known formula.

To extend this method to three branches, lay off, on A C,



GRAPHICAL DETERMINATION OF JOINT RESISTANCES.

A G equal to r_3 and draw G F, giving H K as the required result. This may be repeated for any number of branches. It is apparent that although a diagram of six lines is necessary for two resistances, each additional branch of the circuit necessitates the drawing of only two extra lines, while the arithmetical solution of the problem becomes more and more complicated as the number of branches increases.

If the joint resistance and that of one branch are given, the resistance of the other branch may be found by a slight modification of the same diagram.

INFLUENCE OF THE ELECTRIC DISCHARGE ON ARGON.

According to a cable despatch, M. Berthelot, the distinguished French chemist, supplies the first bit of solid information concerning the chemical properties of argon. He found that under the influence of a silent electric discharge it combines with various organic compounds, notably benzine. It is decidedly interesting to discover that argon, which has been vainly subjected to all the most potent agencies at the command of the chemist, is capable of forming a variety of combinations under conditions which always exist in the atmosphere. M. Berthelot pointed out years ago that nitrogen combines under the influence of silent discharges with hydro-carbons like benzine, with carbo-hydrates such as build up the tissues of plants, and even with tertiary products such as ether. A bit of moist filter paper, for example, exposed to a silent discharge in the presence of nitrogen, absorbs a considerable amount, producing a nitrogenized compound which on heating with soda-lime gives off an abundance of ammonia. As argon seems to be absorbed in the same way, it will be very interesting to learn whether its compound also yields ammonia or what else. M. Berthelot promises further details soon.

M. Berthelot continuing his experiments found that in manipulating argon he developed at an ordinary pressure a magnificent fluorescent substance greenish yellow in color and characterized by a spectrum similar to that of the Aurora Borealis. From this he deduced that the northern lights are caused by fluorescent matter derived from argon and engendered through the influence of electric charges developed in the atmosphere.

DETERMINING THE CONDUCTIVITIES OF BAD CONDUCTORS.

At a recent meeting of the Philosophical Society, Prof. J. J. Thomson read a paper "On a Method of Determining the Conductivities of Badly Conducting Substances." A sphere of the substance the conductivity of which is to be determined is placed inside a coil A through which very rapidly alternating currents are passing. The currents induced on the sphere react on those in the coil. A small coil B placed in series with A contains a highly exhausted bulb in which a ring discharge is produced by the alternating currents. Any change in the intensity of the currents through A produces a change in the brightness of the discharge through the bulb inside B. The effect produced by the sphere inside A is measured by the change in the brightness of the discharge within B, and as the effect produced by the sphere depends on its conductivity, the observation of changes in the brightness of the discharge makes it possible to compare the conductivities of different substances. The paper contained applications of this method to the study of the conductivity of electrolytes under very rapidly alternating currents, of rarefied gases, of gases when entering into chemical combination, of flames, and of the effect of the formation of drops of water from aqueous vapor.

TEMPERATURE OF INCANDESCENT FILAMENTS.

Professor Weber has lately given the results of a number of experiments made by him to determine the temperatures of filaments in electric incandescent lamps. He has found that the normal temperatures of all species of incandescent lamps is approximately the same, and is comprised between 1,565 and 1,588 degrees centigrade. In the case of some lamps giving a very brilliant light, that is to say, with very thick filaments, the temperature is 40 degrees higher.

A THREE-PHASE WATER WORKS FOR CANANDAIGUA, N. Y.

The village of Canandaigua has let recently the contract for the construction of a new water works system. The pumps will be operated by means of power electrically transmitted, on the three phase system of the General Electric Company, which company will supply all the electrical apparatus.

The power house will be located at the foot of Main street on Canandaigua Lake, and will contain one 100 K. W. three phase generator delivering current at 2080 volts. This will be driven by a steam engine. The current will be transmitted to the pumping station 18,000 feet distant, on the shores of the lake 3,500 feet from the reservoir. The pump house will be occupied by two one million gallon pumps, directly geared to 100 H. P. induction motors, wound for 2080 volts and revolving at 600 revolutions. The duplication of the pumping system has been determined upon in order that the work may be carried on continuously even should one pumping equipment break down. An automatic signal alarm will indicate at the power house when the reservoir is full.

SOME CENTRAL STATION AND TRANSMISSION ELECTRICAL LOSSES.[1]

BY A. B. HERRICK.

THE above title embraces a subject of vast importance, and it is by studying these losses closely and reducing them consistently that the future cost of production of electrical energy is going to be reduced under our present systems of generation and transmission in central station practice. Unfortunately, there is no general solution, except when the details bearing on a given problem are known. From the form of potential energy stored in the coal burnt under the boilers until it has passed through the meter of the consumer in the form of electrical energy, there is a gradual frittering away through all the processes of translation, and this waste and these losses have to be paid for by that current supplied for useful results in translating devices on the premises of the customer.

I will dwell as briefly as possible on some of the losses, both inherent and extraordinary, that occur in the transmission of electrical energy from the brush of the dynamo to the meter of the customer. In general, station losses may be classed under two heads: First, the losses that occur in the transference of electrical energy in any conducting medium. This is an inherent loss. Second, extraordinary losses, from badly proportioned conducting systems, unsystematic location of the central station regarding the distribution system, uneconomical methods of control and regulation, and many other details of central station construction that may reduce the whole investment below a dividend earning basis through the annual cost of these losses.

In the laying out of the conductor system, losses may be seriously increased by indirect methods of reaching the point of delivery and supply, or the station may have been located too far away for the average centre of distribution for the purpose of obtaining some economical result, such as water for condensers, coal handling, or even for water power, yet the energy lost in transmission to the centre of distribution may over-balance the additional economy gained in production.

Right here comes in a very important factor which enters into the loss problem, that is, the load curve of the station; as the load increases on the station the loss increases more rapidly than the load, consequently the copper that it would be economical to install in a plant with a straight line load would be very different from that required from a load curve having a high peak of short duration. The load curve when considered in connection with losses possesses two elements, that of current and that of time. The product of these two gives us a new factor which is related in various ways to the loss factor.

The average load loss will not give us the commercial value of the total loss. This can only be determined positively when the conditions under which the distributing system is operated are known. There are elements which enter into the general loss problem which can be considered with advantage to the central station manager. One is, what expenses should be charged against the electrical energy lost to determine its cost. Some maintain that all that should be charged against this loss is the cost of additional coal required to produce the current frittered away in that loss; others hold that the charge of the losses should be on the rate of production cost of the current, less those charges which do not vary with the added loss load; and finally, there are some advocates who state that this charge should be made at the selling price of the current. The first argument may be applied in some cases, but with doubtful accuracy; the second method is the ordinary method of charging the loss; the third method is extraordinary, as it is charging against the loss a profit which cannot be made. What these losses cost the plant is a fundamental one, and as these losses drain from the dividends due the investment, their accurate valuation has an important bearing on the commercial showing of the investment.

Since the problem cannot be treated in a broad way on account of the variables entering into the loss factors, attention can be called to details which require careful consideration, in order to bring the losses to a minimum in any plant.

The materials of electrical engineering, especially those used for conductors are more often put in by faith than by test. The station manager who will have his boiler plate tested representing about the one-fortieth of the total invested capital of the plant, will neglect to have his copper tested, which represents from thirty to fifty per cent of the capital invested in the plant; yet an error in selecting the conducting material may seriously affect the dividends, which should accrue to the installation, and the current uselessly applied to heating the earth and increasing the temperature of the surrounding atmosphere. It would be a wise plan, and should always be required, that where there is any considerable investment in copper, to have submitted by the manufacturer a sample piece of fixed dimensions, which can be tested for its conductivity, and where it is used for overhead conductors also tested for tensile strength. There are a number of processes used in the production of copper which do not eliminate from the copper those impurities which seriously affect its resistivity. They are not apparent from anything but a test. The steel and iron manufacturers specify a definite composition and fixed physical properties; so, should the copper producer be required to fulfill certain electrical conditions which are so important to the successful operation of a plant from a commercial point of view.

Over-insulation in low tension cables of large sizes sometimes causes us to pay a high tariff for protection. The electrical insulator is also an insulator for heat. If the covering to the wire is too great it will confine the heat to the conductor, thereby increasing the loss in the conductor, which heat, if radiated or carried off by convection currents of air would produce higher economy; and the unfortunate condition in such a loss is that this loss is cumulative.

The conductivity of compositions is not amenable to any simple formula. The general rule that the conductivity is below the mean of the different metals forming the mixture, gives us a fair insight into what we may expect when the composition is known. High brass, low brass, copper, so-called cast copper, vary all the way from 18 to 89 per cent. of pure copper in conductivity. Spelter and lead are the worst elements that can enter into a brass composition when conductivity is required, as they more seriously affect the conductivity than tin. Of course, metal may be burned or old brass may be introduced into the composition in the pot, and seriously affect the conductivity of the resulting casting. The bronzes, such as phosphor bronze, silicon bronze—are employed for their mechanical properties rather than their electrical.

To take the volts drop on a connection and multiply it by the amperes passing, will give the watts at that particular current density; but where it is a matter of contact surface, the drop will not follow as quickly as the current rises. To assume that this is proportional leads us into very grave errors. We have in the case of contact a negative coefficient for temperature; we may explain this, in this way; that as the contacts expand they tend to present more surface of contact, and are under contact at a higher pressure than when at normal temperatures. The effect of increased efficiency of a joint at elevated temperatures is very clearly shown when the parts in contact are held by a steel bolt. Both brass or copper expand faster than the iron bolt, and under these conditions one can enormously increase the pressure on the contact, and decrease the losses at the joint. The conductivity of the iron bolt is not of as much importance as this increased pressure by unequal expansion of the different parts of the conductor. In specifying any system of conductors or operating devices, the losses should be expressed at full load, in volts drop. As a rough criterion of the losses occurring in the different parts of the system, note the rise of temperature. Of course, this is crude, but nevertheless it bears some relation to the losses that occur in the conductor. There is also a condition where temperature elevation does not show the true loss, as the radiating surface may be increased to such an extent that the energy may be radiated, and the temperature remain normal under an abnormal loss.

In connection with the arrangement of conductors, every advantage should be taken of methods of making indirect measurements by means of drops across shunts or diverting part of the current to be measured through the measuring apparatus. Even the system of interlocking devices, working switches at a distant point by mechanical means for the purpose of controlling the different circuits, will show a large economy over the current carried to the point of operation, and returned. In fact, I would not be surprised to see at no distant date the switch board gallery of low tension stations with operating devices to distant switches, so that but a small portion of the total output of the station need be brought to the operating gallery for the shunt ampere meters, volt meters and field currents. Economics in the central station operation of the future are to be gained through the means of rigid and consistent economy, keeping the losses of energy at the lowest point possible, in order that we may get the maximum delivery at the meter of the customer for a given consumption of coal, attendance, loss and depreciation.

There are certain lines on this subject which seemingly show very promising results in regard to increased economy of distribution and operation, and in future installations a great deal more attention will be paid to the details bearing on economical transmission of the manufactured product, so that there will be less difference than exists now between the readings of the station's total output, and those of the consumers' meters.

1. Based on notes prepared by the author for the National Electric Light Association at Cleveland, Feb. 19-21, 1895. (Prepared specially for THE ELECTRICAL ENGINEER.)

ELECTRIC UTILIZATION OF WATER POWER AT KEOKUK, IOWA.

THE Des Moines Rapids Power Co. has been granted a charter to maintain and operate a water power in the Mississippi river opposite the city of Keokuk, Ia. The company proposes to build a suitable plant to furnish a power equal to 27,000 H. P. per year. This company has made an offer to furnish the city of Keokuk, with 1,000 H. P. for the price of $80 per H. P. per year providing it builds and operates the plant.

ELECTRIC TRANSPORTATION DEPARTMENT.

"PORTELECTRIC" PLANS.

The *Boston Journal* understands that a consolidation of all the Portelectric companies is proposed, the New England, which has a capital stock of $2,000,000, the International, with a capital of $50,000, and the United States, with a capital of $10,000,000. The capital stock of the new company is to be $7,000,000. New England stockholders are to exchange their stock dollar for dollar, that is, 50 shares of New England stock of par value of $2 per share for one share in the new company of $100 par value.

A NEW AMUSEMENT FOR THE QUAKER CITY.

The Philadelphia Traction Company has had almost every car of the Twelfth and Sixteenth street lines fitted with a fender. A conductor of one of the cars of this line says that as many as 13 small boys have deliberately jumped into the fender net of his car in a single day. The venturesome urchins leap into them just as the car starts from a street crossing and are usually carried a block before they are dumped out by the irate motorman. This risky sport of the small boy has become such a nuisance that orders have been issued to have them arrested.

HOW THE TROLLEY IS GROWING.

Charles E. Curtis gave recently at New Haven, Conn., a brief résumé of some statistics which he has been recently collecting. He wrote to the mayors of fifty of the principal cities in the United States asking for information concerning their street railways. Replies were received from thirty-six and they showed that the combined stocks of the companies in these cities amounted to $410,000,000 and their bonds to $254,000,000, making a grand total of $664,000,000 or one million more than all the national banks the country over are capitalized for.

A SLIPLESS CAR WHEEL.

Leonard Roll, an employé of the Vulcan Iron Works, of Wilkesbarre, Pa., has invented a slipless wheel especially designed for electric cars. The wheels have slots which run through the runs of the wheels. These slots are so tapering that they do not choke up and they cut through the snow and ice like a saw. The ordinary wheel is smooth, and the moment it strikes an icy rail or a lot of snow it whirrs around and the car can proceed no farther. The slipless wheel grinds through this to the rail and throws the accumulation of snow and ice to the side of the track.

ANOTHER TROLLEY ON LONG ISLAND.

T. W. Fanning and Capt. J. L. Tooker, owners of the steamer Nonowantuc of Port Jefferson, L. I., have been completing arrangements for the construction of a trolley road on Long Island. The project is to cross Long Island from Port Arthur to Patchogue, a distance of fifteen miles. A number of local capitalists are interested in the scheme, and it is claimed all the stock necessary to begin the work has been subscribed. The new company will also endeavor to secure permission to carry oysters and other freight. The trolley lines will make close connections with the steamer, which plies between Bridgeport and Port Jefferson.

THE BURLINGTON, N. J., STEAM BRANCH TROLLEY.

For the equipment of the Burlington trolley branch of the Pennsylvania Railroad Co., the Westinghouse Company will furnish the engine and generator, which will be of 300 H. P., and a Climax boiler will be installed. Three motor cars 43 feet long will be built by the Jackson & Sharp Company, of Wilmington. They will be combination cars, for baggage and passengers, and will be equipped with Westinghouse motors and car equipments. Two of these cars will be provided with two motors of 75 H. P. each, making 150 H. P. to a car, and these motors are to drive the cars at a rate of 45 to 60 miles an hour. The third car will have four motors of 50 H. P. each, a total of 200 H. P. Railway motors of 75 H. P. are unusual, and those for service on these cars are to be built especially for them. The use of four motors on a car is also an experiment. These cars are intended to draw one, two or three Pennsylvania Railroad coaches, such as are used in suburban traffic.

The railroad company itself is to do the track and electrical line work under the supervision of Mr. F. W. Darlington, the electrical engineer, of Philadelphia. All light rails are to be taken up and the entire roadbed will be laid with seventy-pound rails. Freight trains and through passenger trains will be run over the road with steam locomotives attached as usual, as the trolley cars are intended for local traffic alone. It is expected that the road will be ready for the operation of trolley cars not later than June 1.

THE CENTRAL HUDSON R. R. HIT ALSO.

The increased facilities afforded travelers by the Albany Electric Railway Company during the past year, have diverted travel from the Central-Hudson, D. & H. C. Company to such an extent that it is said, the railroad companies have decided to lower their rates on round trip tickets to Troy, from 25 cents to 15 cents. The rates on freight are also to be lowered in the same proportion. Since the advent of the express cars on the electric road, the freight traffic on the belt line has diminished considerably. The electric road's freight station is more centrally located and more easily accessible than the offices of the express companies and as the freight cars arrive and depart from the station, better time between the two cities can be made. The railroad people, realizing these facts, have determined, it is said, to cut the rates in the hope that their lost trade may be restored.

ELECTRIC ROADS AROUND BALTIMORE.

There is no abatement in the formation of projects to extend electric railway lines outward from Baltimore. These street railroads running along the turnpikes, and terminating in some thriving centre of population, bid fair ultimately to connect the city with all the suburban towns within a radius of twenty miles. Within three years Point Breeze, Towson, Roland Park, Pikesville, West Arlington, Walbrook, Gwynn Oak and Curtis Bay have been reached with rapidly-running trolley cars. Roads in process of construction will soon bring Reisterstown and Emory Grove, Weatherdville and Powhatan, Catonsville and Ellicott City into the same charmed circle, while ambitious projects are on foot to extend lines to Gardenville and Mount Washington. Beyond this are dreams of the Washington boulevard, a road to Annapolis, others to Belair and Westminster, with a possible extension of the latter to the battlefield of Gettysburg.

DANGERS OF VESTIBULE TROLLEY CARS.

In the discussion, before the Colorado Legislature of vestibules for the drivers of trolley cars, a number of telegrams from managers of street car lines in various cities were read, showing the results of attempts to thus protect employés. N. K. Bowers of Chicago reported the plan impracticable, and resulting in an increased liability to accidents. J. N. Beckley, president of the Rochester (N. Y.) road, says: "We have vestibules on two-thirds of our equipment. They are not satisfactory, and furnish little protection to motormen, as the front window must be kept open. Our employes like open cars better, even in winter weather." H. C. Campbell, Portland, Ore., states that, after a thorough trial, vestibules were abandoned as unsafe and inconvenient. P. A. B. Widener, president of the Philadelphia company, declares, after trial, that such a plan is impracticable, and tends to increase the liability to accident. These opinions are shared in by the West End company of Boston. Its leading officials have declared that to surround a motorman with a glass enclosure would materially limit the range of his vision, and necessarily enhance the liability to accident. Especially in winter, when the frosts are heavy, would there be an increase of danger.

ELECTRIC TRACTION AT THE EARNOCK COLLIERY, ENGLAND.

An interesting paper was read at a recent meeting of the English Institution of Civil Engineers by Mr. Robert Robertson, describing an electric haulage plant at Earnock Colliery. The daily output of the shafts is 1,200 tons. The electrical generating plant comprises a dynamo for supplying power to the electric hauling engines, capable at a speed of 620 revolutions per minute of an output of 100 amperes at 490 volts. It is driven from a shaft direct coupled to two single-acting Westinghouse engines, having cylinders 18½ in. in diameter, with a length of stroke of 12 in., and developing together, when running at their normal speed of 350 revolutions per minute, 122 H. P., with a steam pressure of 50 lbs. per square inch. The conductors are highly

insulated, sheathed in iron pipes in the shaft and supported upon insulators in the workings.

There are two electric hauling engines. One of these, when running at a speed of 770 revolutions per minute, develops 35 H. P. with a current of 76 amperes at a pressure of 400 volts. It is geared, through an intermediate shaft, to two pulleys with Hurd clips, each provided with a friction clutch and brake, by which the ¾ inch steel cables are driven at a speed of three miles per hour. After passing over balance-wheels placed in recesses near the engines, the cables operate circuits of 2,160 yds. and 1,020 yds. in length, respectively. They are supported at intervals of about 30 ft. along the roads by rollers 4½ in. in diameter; and at the corners are passed over wheels 5 ft. in diameter. In the main coal seam another cable operates similarly a circuit 1,580 yds. in length.

The electrical haulage system in the Ell coal seam is capable of a daily output of 400 tons. The daily output by horse traction has been 180 tons. The yearly working expenses of the two systems were compared, upon the results of one and a half year's working, and were found to be £4,130 and £1,990 by horse traction and by electrical haulage respectively, showing that an annual saving of £2,140 had been effected by the latter. The total cost of the electrical installation was £3,500.

TELEPHONY.

THE M. & B. TELEPHONE SYSTEM.

THE accompanying engravings represent two of the numerous types of telephone instruments now being constructed by the M. & B. Telephone Co., of the Bullitt Building, Philadelphia. The distinguishing feature of these instruments is the utilization of the original make-and-break method of transmitting articulate

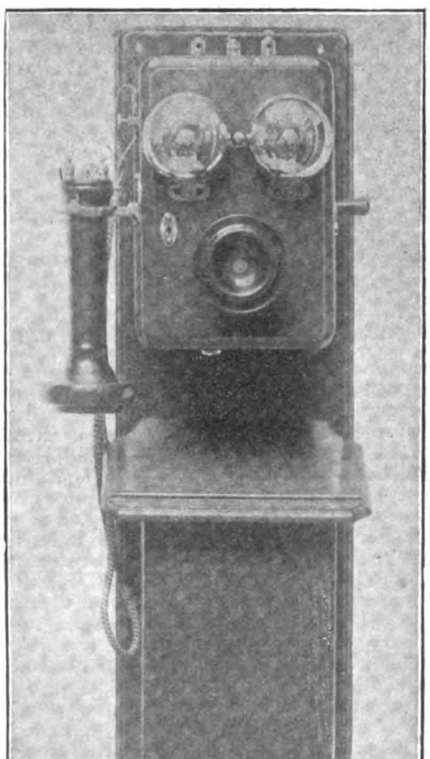


FIG. 1.—M. & B. EXCHANGE WALL SET.

speech, for which the company claims to have a fundamental patent and which method it also claims permits it to secure better articulation than can be obtained with the closed circuit method.

The transmitter is exceedingly simple, consisting of a suitable ball rolling on an inclined plane, with a contact point attached to the diaphragm. A complete make and break of the circuit occurs with every vibration of the diaphragm, between the point and the sphere.

In the engravings, Fig. 1 represents the exchange wall set with battery box, and Fig. 2 the desk set. The former is fitted with a receiver hook of novel design and calculated to assist the central office operator in her work. When the subscriber rings up "central," the ground is automatically removed after a few turns of the magneto handle and the bell stops ringing. On now taking the receiver from the hook the latter retreats into the magneto box. When the conversation is finished the subscriber can not hang up his receiver until he has "rung off," because the hook is inaccessible until the ringing of magneto automatically brings it

FIG. 2.—M. & B. DESK SET.

out of the magneto box. This makes "ringing off," compulsory and increases the efficiency of the service.

The M. & B. system also comprises a switchboard which for a capacity of 1000 subscribers occupies a space of only 2 feet high by 6 feet long, and it is claimed that one operator can handle a considerably larger number of subscribers than is possible with the type of beard in use at present. Another feature of the board is that the operator can not cut in on subscribers and listen to conversation, so that secrecy is maintained. The board can be arranged for either grounded or metallic circuit and is claimed to be fire-proof. The company also manufactures a toll line switchboard to connect cities with outlying towns and villages, and telephone instruments for short line work of all kinds.

THE HUDSON RIVER TELEPHONE CO.

The annual report of the Hudson River Telephone Company shows a prosperous state of affairs. The following is the summary of the report read at the recent annual meeting:

Gross revenue for 1894, $260,977; expenses, $178,857; net revenue, $82,120; increase over 1893 in gross revenue, $11,147.44; decrease in expenses, $8,369.33; gain in net revenue, $19,516.77; revenue collected for toll service, $34,692.01; charge upon revenue for royalty, $40,997; cash on hand, $17,108; surplus, $29,099.

The following officers were elected:

President, Selden E. Marvin; vice-president, James H. Manning; secretary and auditor, Walter B. Butler; treasurer, James J. Fitzsimmons; general manager, Henry E. Hawley; inspectors, H. E. Hawley, W. B. Butler and J. J. Fitzsimmons.

THE "CLINTON" PLAN OF EXCHANGE RENTAL.

The new telephone exchange at Clinton, Ill., is to be operated on a new plan which will be watched with interest in other cities where telephones are now in common use. Every subscriber at Clinton will own his own telephone. When it is put in his place of business he will pay thirty dollars for it and it will then be his individual property. Each month he will be required to pay seventy-five cents towards defraying the expenses of the central office and paying the salary of a manager, whose duty it will be to make all repairs and keep the line in working order. The exchange will start with about fifty subscribers. The projectors are satisfied that they can make the undertaking a success.

TELEPHONY IN INDIANAPOLIS.

The Indianapolis Board of Works has drawn up a proposition to telephone companies wishing to operate in that city, the salient features of which are as follows: Telephones in business houses shall not cost more than $3 a month and in residences not more

than $2, these rates to be for all distances within the city. The city is to have the use of as many instruments as it needs at $1.50 a month. Where two instruments are used on one line and only one has direct connection with the exchange the charge for the extra instrument is to be not more than $1.50. The company is to pay into the city treasury $12,000 a year. All wires in the down-town district are to be placed under ground and the company is to build conduits of sufficient size to accommodate all other wires in the city, for the use of which the company is to have just compensation. The franchise is to run ten years.

The telephone companies are preparing counter propositions to submit to the Board of Works.

TELEPHONE NOTES.

THORNTOWN, IND., is moving for a telephone exchange.

SPARTANBURG, S. C.—The Spartanburg Telephone Company has been organized.

EATON RAPIDS, MICH., will probably have a telephone exchange in the near future.

ADAMS, MASS.—The New England Telephone Company have decreased their rates.

SHREVEPORT, LA.—The Monroe Telephone Company is an assured success.

BUTLER, PA.—The People's Telephone Co. is a new enterprise in Butler and it proposes to reduce rates one-third.

MIDDLEBURGH, N. Y.—The Middleburgh and Oak Hill Telephone Co. has been incorporated with a capital stock of $500, to operate a line of telephone from Middleburgh to Durham.

MILWAUKEE, WIS.—The Strowger Automatic Telephone company is making arrangements to establish its service in Milwaukee.

SAN JOSÉ, CAL.—H. J. Edwards has petitioned the Common Council for a franchise to conduct a telephone system in this city.

CHICAGO, ILL.—The Bureau County Telephone and Telegraph Company has been formed; capital stock, $1,500; incorporators, Joseph W. Ross, John H. Knight and A. E. Burres.

PORTLAND, ME.—The Casco Bay Telephone Company has petitioned for permission to erect poles on the streets necessary to give them a complete telephone service.

HINTON, W. VA.—The Hinton Telephone Co. has been granted a charter with J. T. McCreery, Harvey Ewart, P. K. Litsinger, B. L. Hoge, J. M. Ayres and E. L. Briers as incorporators.

BOONE, IA.—A company of Boone business men has filed articles of incorporation of the Boone County Telephone company, and will apply to the city council for a franchise.

WOODSVILLE, N. H.—The Wells River Valley Telephone Co. has had its name changed, and now will be known as The Great Northern Telephone Co.

MOBILE, ALA.—It is proposed to organize a company to establish a telephone system of 400 instruments, and about 900 subscribers have been secured. D. R. Burgess, E. O. Zadek and S. L. Hahn are interested.

MONROE, LA.—The proposed telephone company has been organized with W. B. Reily, president; W. L. Morris, vice-president, and J. H. McCormick, secretary-treasurer, and the capital is to be $7500.

COLDWATER, MICH., will probably grant a franchise authorizing the Southern Michigan Telephone Co. to erect poles and do business there, the city reserving the right to use the poles for a fire alarm system if so desired.

MOBILE, ALA.—The board of directors of the Home Telephone Company at Mobile has met and organized by the election of the following officers: H. Piser, president; James K. Glennon, vice-president; W. H. Fitzpatrick, secretary; Adam Glass, treasurer.

WALTHAM, MASS.—The New England Telephone and Telegraph Co. has filed plans asking for underground conduits. The company wants to lay out four ducts of creosoted wood; the distance covered will be about 4600 feet.

BINGHAMTON, N. Y.—Messrs. Geo. W. Dunn, John Bayless, Cyrus Strong, Jr., F. W. Downs, Ed. L. Rose and C. H. Hotchkiss submitted a petition asking for the right to operate a telephone business in this city.

NEWPORT, KY.—The Citizens' Telephone Company of Newport has filed articles of incorporation in the office of the Secretary of State. The names of the incorporators are C. W. Coffin, Cincinnati; J. R. Megrue, Cincinnati; Alex. Davezac, Covington; W. H. Glore, Covington; W. H. Harton, Newport. The capital stock of the corporation is to be $60,000.

PARSONS, KAS.—There is a project on foot to construct a telephone system between Oswego and Parsons.

CASSOPOLIS, MICH.—Cassopolis will have a telephone exchange this spring connecting with Forest Hall, the popular summer resort at Diamond Lake.

BALTIMORE, MD.—The Home Telephone Company hopes to secure many business houses as subscribers and it will make a special bid to obtain residences.

STATEN ISLAND, N. Y.—The Staten Island Automatic Telephone Company has been given consent to erect poles in the village of Port Richmond.

ELIZABETH, N. J.—Mayor Rankin, it is understood, has approved the franchise recently granted the Mutual Telephone Company, and the work of building the plant will be at once begun.

HAZLEHURST, MISS.—The Price-King Telephone Company is now erecting a telephone connecting this place with the town of Crystal Springs. The originators of this enterprise are P. B. King, H. C. Price and Dr. F. M. Sexton.

MEMPHIS, TENN.—L. E. Drake, representing the American Construction Telephone Company, of Anderson, Ind., has been here with a view to forming a local stock company and putting in a telephone plant.

VICKSBURG, MISS.—The Great Southern Telephone Company has announced a prospective early reduction in box rentals, and has reduced the rental of isolated plantation telephones to $15 per annum to take effect July 1.

ANTWERP, O.—A telephone company has been organized which will be managed by W. E. Osborne, R. E. Ringany and Milton Shirley. The line will connect Antwerp with Payne, Worstville, Briceton, Latta and Paulding.

BRISTOL, TENN.—The Bristol Telephone Company, which proposes to complete the East Tennessee Telephone Company here, has its new exchange nearly ready for operation, and it will be only a few days before telephone service in Bristol is reduced one-half in price.

MARSHFIELD, WIS.—The telephone line between this place and Hewitt, a distance of five miles, in which one of the barb wires of a fence extending along the right of way of the Wisconsin Central Railroad is used, is a success. It was tried as an experiment, but works so well that it may be extended to Auburndale.

JERSEYVILLE, ILL.—At a meeting of the Jerseyville Telephone Company the following directors were elected: John G. Schwartz, Wallace Leigh, John A. Shephard, and Joseph M. Page. The latter was elected president and John A. Shephard secretary and treasurer.

STOCKTON, CAL.—The California Telephone Association has been incorporated. The incorporators are M. Louis of Boston and M. S. Arndt, Gus Gumpertz, Mrs. E. Arndt and Frank E. Lane of Stockton. The capital stock is $100,000, divided in 1000 shares. Each incorporator takes 200 shares.

ST. JOSEPH, MICH.—A few weeks ago the Gilliland telephone company of Chicago was granted a franchise here, and was to charge $24 a year for telephones in business houses. The Bell telephone company, which has for years been charging $48 a year, announces a rate of $18.

HAVERHILL, MASS.—"The Peoples'" is the latest telephone company in the field whose purpose is to furnish telephonic communication at a greatly reduced rate. This company is organized under the laws of Massachusetts, with Edward H. Hoyt of Haverhill as president and principal stockholder.

PITTSTON, PA.—A local telephone company, which has for its object the establishment of telephone lines in Pittston and West Pittston, has been organized. Louis Seibel was elected president; F. Seymour, of New York, vice-president; Dr. E. B. Long, secretary, and J. B. Shiffer, treasurer.

PITTSBURG, PA.—A telephone syndicate that will operate in opposition to the Bell Company is a move that is now on foot. The capital will be at least $500,000. J. E. Keelyn, President of the Western Telephone Construction Co., of Chicago, is one of the promoters of the plan.

SUPERIOR, WIS.—A joint petition from the postmasters at West Superior, Duluth, West Duluth, Superior and South Superior, has been sent to the department asking that the five offices be connected by telephone, it being thought that the improvement in the mail service will more than offset the expense.

INDIANAPOLIS, IND.—The Indianapolis Phoenix telephone company has been incorporated with a capital stock of $200,000. The shares are divided into units of $100, ten of them being taken by Alfred B. Gates, Rufus K. Syfers, Charles A. McCleary, William N. Gates, George W. Stout, Charles F. Smith, George C. Webster, Edward M. Churchman, R. H. McCrea and Benjamin L. Webb.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Communications for the Editorial Department should reach it not later than Thursday. Copy for advertisements should be handed in not later than Friday.

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CONTENTS.

IN MEMORIAM—GEORGE M. PHELPS.

LIFE is, at best, held on precarious tenure, but they who knew Mr. George M. Phelps were never reminded of that grim fact by anything in his manner or bearing. Up to the hour of his sudden attack by pneumonia last week, he maintained the same poise and sturdiness, the same dignity and solidity; and it did not seem possible that one so squarely set to resist by every attribute the buffets of physical ailment or the shocks of mental distress, could succumb to death. Even now that he has gone, his presence is acutely real in each familiar haunt, and his aspect is vivid to the eye of every friend.

To tell the sober truth, Mr. Phelps died a sacrifice to brotherly devotion, assuming fatigues and duties to which only the deepest love and an intense affection could prompt any man. But that was all in keeping with the tenor of his life, while it was also not a little characteristic of his resolute will that neither warning nor solicitation could induce him meanwhile to take care of himself. Of such stuff are heroes made.

In his larger relations with society, the world judged Mr. Phelps aright, and sought him for its offices of responsibility, to which he gave willingly the exercise of a luminous and unselfish judgment. In the more intimate affairs of business, his associates can only say that he governed himself by lofty ideals, and never swerved from justice save on the side of generosity and charity. No man ever approached technical journalism with purer purpose than did he, and the last words he said in the office of THE ELECTRICAL ENGINEER were those of pleasure at the work it had tried to do and of the many opportunities of service that still lay before it. He was a delightful companion, responsive in the most sympathetic manner to all that concerned the welfare of those near him ; and they who now go forward with the work he began, look backward before they do so upon five years of happy, confidential association, in which, be the differences of opinion and view what they might, not a moment's cloud obscured the sunshine of a perfect friendship.

"THE ELECTRICAL ENGINEER."

Owing to the death of Mr. George M. Phelps, president of THE ELECTRICAL ENGINEER, a change in its management has been rendered necessary, and has now been effected. Mr. T. C. Martin has been elected president; Mr. Joseph Wetzler, vice president and treasurer; Mr. A. C. Shaw, secretary and business manager. Mr. Shaw will

have the assistance in New York of Mr. A. C. Boughton, and will continue in special charge also of the New England office. The ENGINEER counts itself fortunate in the merited promotion of both these latter gentlemen, already so well known in its service. It may be added that Mr. W. F. Hanks will continue in charge of the Philadelphia office, and Mr. Carl Kammeyer in charge of the Western office. No change will be made in the editorial department except to reinforce it with valuable aid, for which arrangements have already been carried out and of which later announcements will be published in due course. The ENGINEER wishes to record here its deep sense of obligation to the host of friends who have hastened to express regrets at the loss of its lamented president and to assure it of continued active good will. While conscious that the high record of The ENGINEER in the past imposes a difficult standard of accomplishment, those now in charge of its affairs venture to hope that by adherence to right methods and by an absolutely independent attitude with regard to the great interests and questions in the electrical field, it will be found better and stronger and more influential than ever.

LONG-DISTANCE MICROPHONE TRANSMITTERS.

In the design of telephone transmitters, it is a comparatively simple matter to put together two carbon electrodes, and, using a weak current, transmit speech; but to make electrodes which are capable of carrying a strong current respond to the vibrations caused by the voice is quite another matter. It is this that has been done in a marked degree in the "solid back" transmitter and has made that instrument, combining excellent *articulation* with large *volume*, probably the most powerful of any yet put into commercial use. It is apparent that the design of the well-known "solid back" instrument has been closely followed in the interesting Jacques vibrating microphone described in our issue of March 27. The similarity is most noticeable in the construction of the variable carbon resistance. The principle of inclosing a quantity of granular carbon in a shallow cylindrical cup the bottom of which is firmly fixed to the framework of the instrument, while the top is attached to the diaphragm and is free to move with it, is the chief peculiarity of both instruments. The success which has attended this construction of the variable carbon resistance, indeed, is likely to influence transmitter design for a considerable time.

As volume, which depends mostly on strength of current, is a prime necessity in a transmitter for long distance work, it is clear that the object of the Jacques transmitter is to secure that quality by the use of a larger source of current than is employed in the solid back instrument, but in substantially the same way.

In regard to the use of a greater battery, in general, it may be pointed out that one of the disadvantages from which the telephone has suffered as compared with telegraph has been the difficulty of increasing the voltage of its battery in proportion to the length of the line—a disadvantage intensified by the fact that the entire source of current used in working one way is confined to a local circuit at the sending station. The difficulties of maintaining batteries at subscribers' stations in good condition are obvious, not to mention the uneconomical feature of installing and renewing a battery system subdivided among stations scattered all over a city; and it is to be regretted that this attempt to get better results from increased current should tend to aggravate this unfortunate characteristic of the telephone. It is especially so, now that the problem of removing batteries from subscribers' stations and centralizing them in exchanges is nearly, if not completely, solved. It is certain the time is not far distant when subscribers in exchange systems will get their current from the central offices, and in that respect the Jacques transmitter would appear to be somewhat behind the march of events, though, no doubt, it may be possible to adapt it to the common battery sharing system. However, the means adopted to cut down the noise in the receiver at the sending end of a line due to the sensitiveness and power of the Jacques transmitter, it would seem, could be applied to the present styles of telephones with much benefit, as with the solid back transmitter the same annoyance is experienced.

The chief device at present in use for this purpose has been a push button to short-circuit the secondary of the induction coil. It gets rid completely of the noise but as it is impossible to transmit while the button is pressed, one hand of the person telephoning is occupied in its manipulation. As the other hand holds the receiver, it is not possible to write, and on that account the push button is not altogether satisfactory. Recent improvements in the design of the induction coil have, it is true, largely decreased the necessity for the push button, but the evil is not entirely remedied.

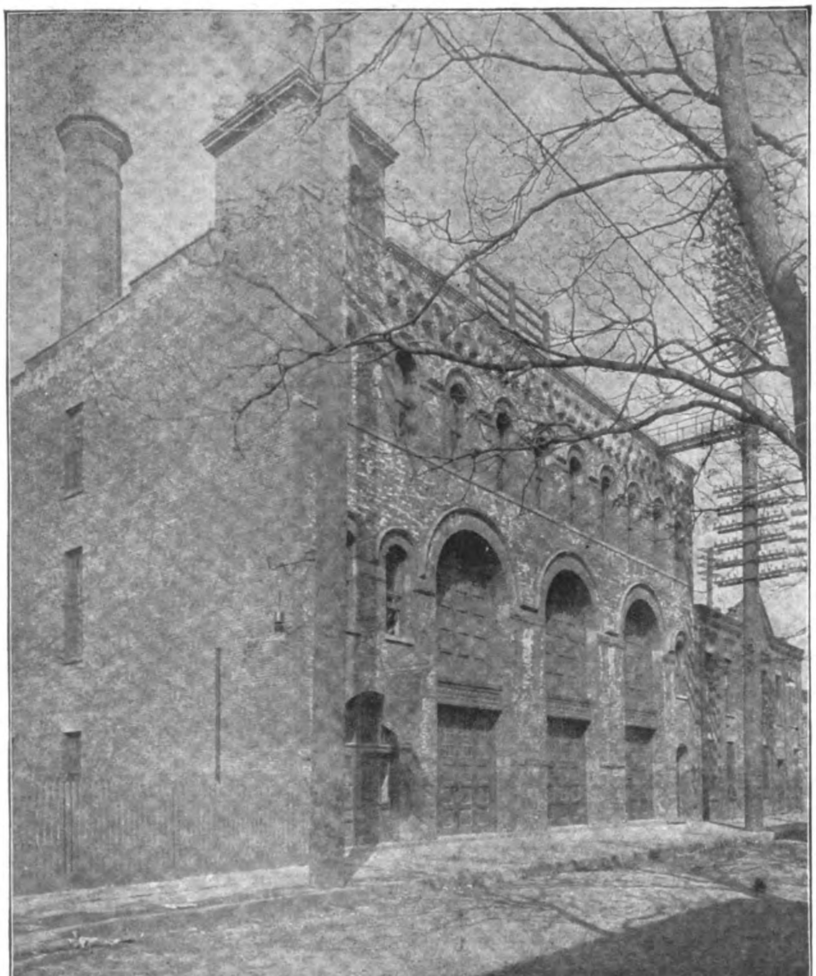
Using a differential receiver having one of its coils in series with a local balancing resistance would be a much neater way of overcoming the difficulty. It may be stated, in reference to the differential receiver method, that a perfect balance is neither necessary nor practically possible. The noise it is desired to cut down is much less persistent than the voice sounds, and an imperfect balance should be sufficient to reduce it. Even were a receiver balanced on a line of a definite length, on another the conditions would be entirely different, and the balance obtained in one case would be altogether upset in the next. Of course, the differential method has its drawbacks too, and the point to attack the problem of overcoming the noise is in the transmitter itself where it originates. Whether that can be done in transmitters using the solid back type of variable resistance is rather doubtful; the Jacques instrument in itself admittedly increases the trouble.

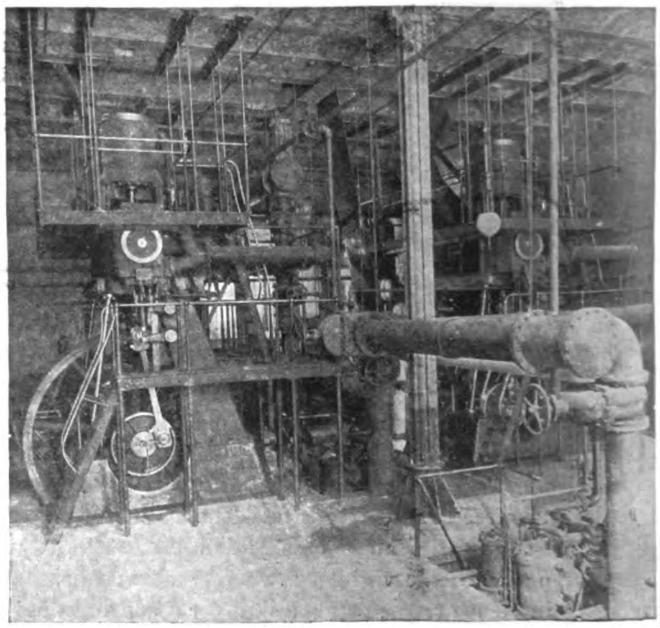
It will be interesting to note if the Jacques transmitter overcomes the common failure of granular transmitters—the tendency of the loose carbon to "pack." When packing occurs, the efficiency of the transmitter falls enormously, and the worst fault of the solid back instrument is its liability to this trouble. If a strong current will prevent this, it is a point of much importance. If it does, it will go far to warrant the belief that the granular carbon transmitter "has come to stay." If it does not, invention will certainly run in the direction of some other form of electrodes not open to this serious objection. Perhaps, indeed, it may turn out that other suggested substances, such as oxydized metallic granules may possess the properties of carbon without its packing propensities.

NEW STATION OF THE CITIZENS ELECTRIC ILLUMINATING COMPANY, BROOKLYN, N. Y.

The Citizens Electric Illuminating Company, of Brooklyn, N. Y., have recently erected an extensive addition to their plant located at Rockwell Place and De Kalb Ave., some of the features of which we illustrate in this issue. The addition is a handsome three story fire proof building, 75 x 100 feet, an exterior view of which is shown in Fig. 1. It is thoroughly equipped in accordance with modern engineering practice.

The first floor is divided into two rooms, devoted respectively to boilers and engines. Two vertical condensing engines of the McIntosh & Seymour manufacture, Fig. 2, have been erected in the engine room, leaving space for four more of the same type. The dimensions of the engines are as follows:—Diameter of high pressure cylinder 13", of the intermediate cylinder 21", and each low pressure cylinder 23"; stroke 24". The engine will develop, with 155 revolutions per minute, and 150 lbs. initial pressure condensing, 400 H. P. economically; that is, with the cut-off in the high pressure cylinder of about four-tenths. The maximum cut-off allowed by the governor gives a large reserve over this.





FIGS. 1 AND 2.—NEW STATION AND ENGINE ROOM, CITIZENS ELECTRIC ILLUMINATING CO., BROOKLYN, N. Y.

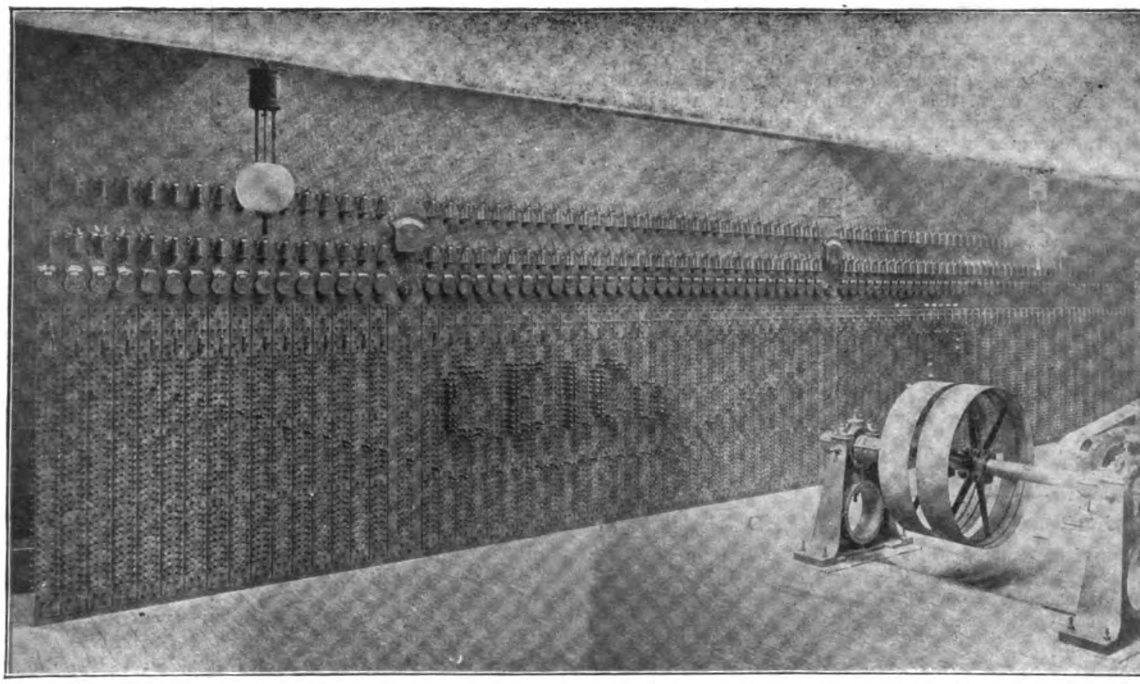
Connected with these engines are two Worthington vertical condensers, each having a capacity to condense 25,000 pounds of exhaust steam per hour, when supplied with injection water at a temperature not exceeding 52 degrees Fahrenheit. Water for the condensers is supplied from a system of driven wells having a capacity of 2000 gallons per minute.

Feed water for the boilers of both the old and new plant is heated by two 2000 H. P. Goubert heaters. A well lighted and ventilated dynamo room Fig. 4 occupies the second floor. Two lines of shafting furnished by the Falls Rivet & Machine Company run nearly the entire length of this room to which are belted at present 28 T.-H. arc dynamos with a capacity of 45 lights each. The leather belting for the main driving belts, namely two 48" three ply belts, and all of the dynamo belts, were manufactured by Chas. A. Schieren & Co.

At one end of this room is a large arc switchboard, Fig. 3, extending nearly the whole width of the building. This board control 96 circuits and 72 dynamos, and is divided into three sections, the dynamos and circuits on each section being interchangeable; and by means of brass "bus" bars extending the entire length of the board, any circuit may be transferred to either of the other sections. The board is made up of a series of slate panels 7 feet long 6 inches wide and 1¼ inches thick, supported by an iron frame at top and bottom. The circuit terminals are vertical strips of brass ¾" x ¼" to which are fastened removable brass sockets. These sockets extend partly through the slate, but do not touch it, the holes in the slate being bored large enough to prevent this. Horizontal strips of brass supported 8 inches in the rear of the board by means of iron bolts fastened to the slate, represent the dynamo terminals. Brass sockets are attached to these strips in the same manner as those to the circuit terminals. A brass plug is used as a connecting link. Precaution has been taken to insulate every piece of live metal from the slate by means of hard rubber. It is impossible by any means, to get into contact with a piece of live metal from the front of the board.

At the top of each panel is an absolute cut-out, by means of which a circuit may be connected or disconnected without the use of the brass plugs. In other words a dynamo engineer may plug the entire board up at his leisure and then use these cut-outs for the final connection at the proper starting time. They also serve as a quick means of disconnecting circuits in case of accident. The remainder of the board is made up of a series of slate slabs, to which are fastened 192 Thomson-Houston lightning arresters, 96 Weston ammeters, specially designed for the work, and three Weston voltmeters connected with multipliers and ground-detecting switches. The whole board is 54 feet long and 13 feet high and is one of the largest in the country. The board was manufactured by V. Prentiss & Co. from designs furnished by the general superintendent of the company.

The offices, stock room, and testing department are on the third floor and are handsomely furnished and well equipped. The officers of the company are as follows: Bernard Gallagher, president; James Shevlin, vice president; John Delmar, secretary; Thos. F. Nevins, treasurer and Edward F. Peck, general superintendent.



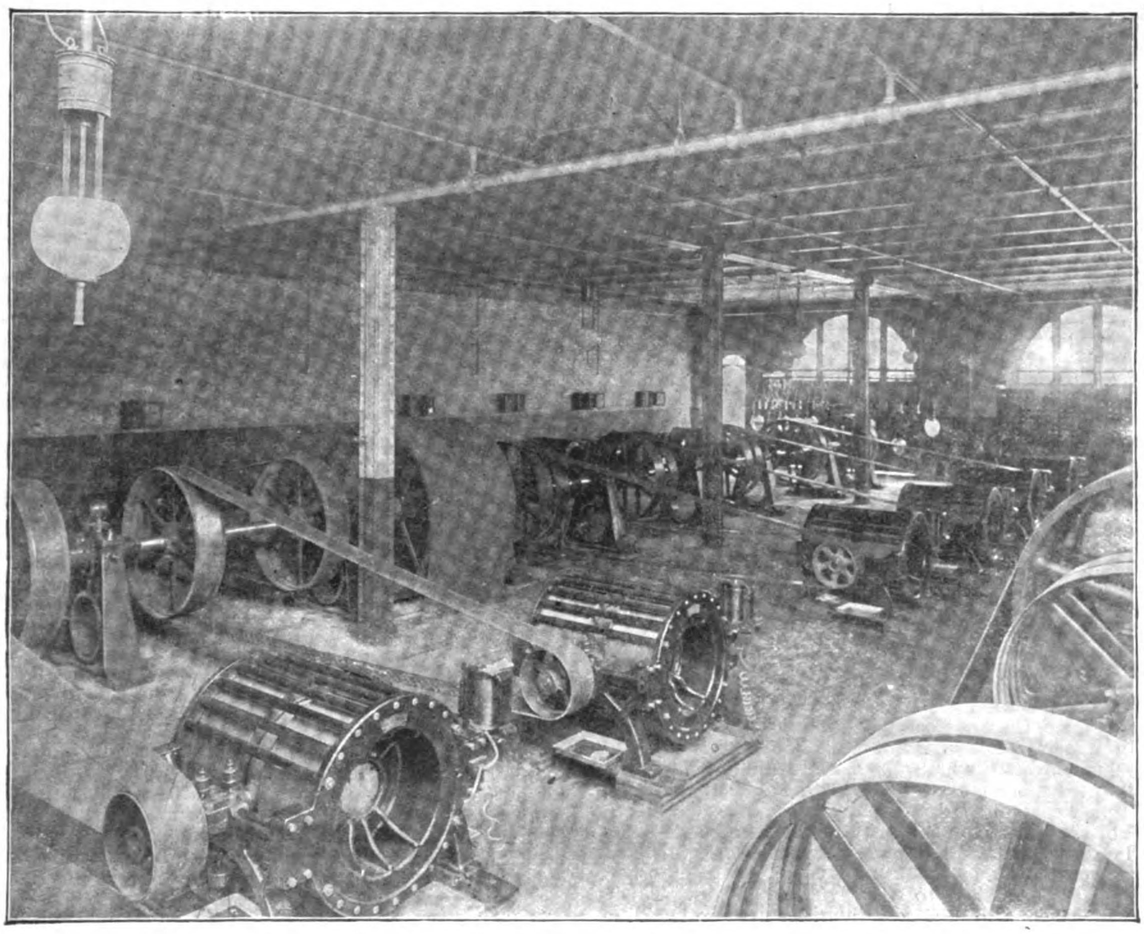


FIG. 3.—ARC SWITCHBOARD CONTROLLING 96 CIRCUITS AND 72 DYNAMOS. FIG. 4.—DYNAMO ROOM, CITIZENS ELECTRIC ILLUMINATING CO., BROOKLYN, N. Y.

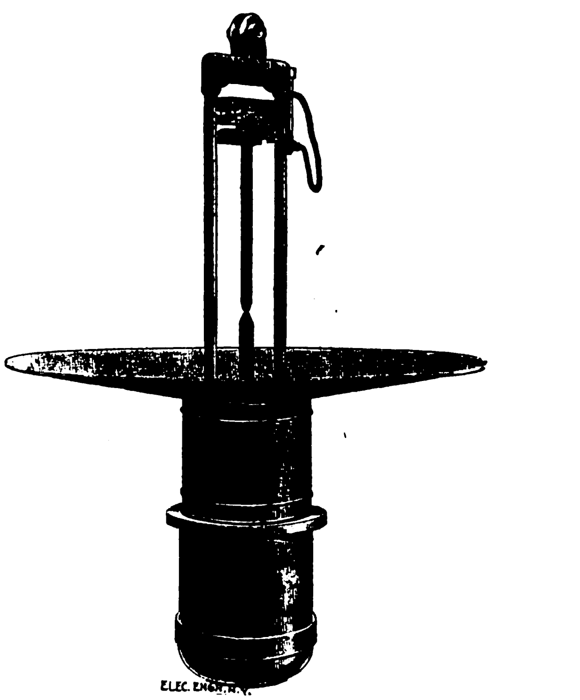
SECULAR VARIATION OF THE EARTH'S MAGNETISM.

IN a recent publication by Dr. L. A. Bauer, entitled "Beitraege zur Kenntniss des Wesens der Saecular Variation des Erdmagnetismus" (Inaug. Diss., University of Berlin), some interesting and important contributions to our knowledge of that enigmatical phenomenon of terrestrial magnetism—the secular variation—have been made. The author has constructed the actual curve described in the course of centuries by the north end of a "free magnetic needle" at various stations (24) distributed over the globe. The result has been the establishment of a law governing the *direction* of the curve, which the author claims is the first law that has been established thus far with regard to the secular variation as applying to the whole earth. This law may be expressed as follows:—The north end of a freely suspended magnetic needle, as viewed from the point of suspension of the needle, moves, in consequence of the secular variation of terrestrial magnetism on the entire earth, in the direction of the hands of a watch. With regard to the period, Dr. Bauer believes that

it has not yet been proved that the earth actually possesses a common secular variation period. The only way he thinks it possible to deduce a common period is by the supposition that the curve described by the magnetic needle is not a single closed one, but consists of loops. Indications of such loops, he says, make themselves apparent at various stations. A comparison is also drawn between the secular variation and the momentary distribution of terrestrial magnetism. A secular wave is followed around the earth with the aid of the projected curves. It would appear as though a continuation of the secular curve is obtained by going around the earth eastwardly. The fact thus revealed, the author says, would have, as a direct consequence, that if a survey be made along a parallel of latitude in an easterly direction, a similar motion of the magnetic needle would be encountered as in the case of the secular variation. Dr. Bauer has carried out this idea for three epochs, viz., 1780, 1829, and 1885, and along several parallels of latitude. The curves described by the needle are projected and given on a special plate. It has been found that in every case the north end of the needle, as observed from the centre of the needle, moves clockwise. Furthermore, by a comparison of both sets of curves—the secular and the momentary--it would appear as though they are subject to similar laws.

REVERSED ARC LAMP FOR DIFFUSED LIGHTING.

The accompanying illustration shows the arrangement of an arc lamp now being largely employed abroad for the uniform illumination of factory rooms. The light from the arc is all thrown upward and reflected from the ceiling, so as to avoid



ARC LAMP FOR DIFFUSED LIGHTING.

shadows. The construction is that adopted by the firm of Kremenezky, Mayer & Co., of Vienna. The regulating mechanism consists of a series and a shunt coil whose cores are connected by a rocking lever to which the wheel train and the brake are connected by means of rods. The feeding is done by the weight of the upper carbon holder when the brake is released by the movement of the lever connecting the solenoid cores.

While the lamp is regulating, the entire wheel work moves in its frame and the carbons approach and recede from each other, even when the brake is applied to the regulating train. This is important where carbons of different qualities are employed, as in such cases the resistance of the arc frequently changes independently of the action of the regulator. If in a case like this the lamp cannot be regulated, the current would increase and remain above the normal until the carbons had burned away. By the supplementary regulation above described, these inequalities are automatically compensated for. The lamp can be used both for continuous and alternating currents; in the latter case a choking coil is added instead of a resistance.

IRON MOUNTAIN, MICH.—The Menominee Range Telephone and Construction Co. has been organized by local capitalists. It will operate exchanges in Iron Mountain, Norway and other range towns. It will furnish instruments for $24 per year.

LETTERS TO THE EDITOR.

LAMPS FROM A CHICAGO DEPARTMENT STORE.

A matter came to my notice to-day which should be of interest to central station managers. A customer of ours received from a Chicago department store three dozen lamps of standard make, the same as we are using here at present. The lot cost him the same as ours cost us in barrel lots. Have not tested the efficiency of the lamp, but it has a short, thick filament and is undoubtedly of low efficiency. Do not feel that we care for lamp business particularly, except on that score, efficiency. When in the market for lamps again, will certainly not patronize the makers of that lamp, and think that if makers were given to understand that the practice mentioned would be frowned upon by central station men, it would tend to check it greatly.

O. B. PLAYTER,
Rice Lake Water Works Co.

RICE LAKE, WIS.

COST OF LIGHTING BY MUNICIPAL PLANTS.

PLEASE allow me to make a correction in the figures given by Mr. I. C. Wood in the article on "Electric Lighting Statistics" published in your issue of March 20. I do not think he has used them to his advantage as he might. In comparing the instances of South Norwalk, Conn. and Buffalo, N. Y., he gives in the former case an average per lamp of 1,400 candle-power burning about 8 hours for 309 nights in the year, and in the latter an average of 2,000 C. P. burning 4066 hours during the year (or 11.1 hours for each of 365 nights). He then multiplies the candle-power by the number of nights and says this is equal to (in the first case) "1,400 x 309 or 433,300 candle-power during the entire year." What he actually has got, to use the correct unit, is not 433,300 candle-power, but 433,300 *candle-power nights*, and what he should do is to multiply this figure by 8 and thus get the number of candle-power hours, the true unit for quantity of light, which will reduce the cost to an absolute basis of comparison. Similarly also for the case of Buffalo. His table would then become:

	Cost per lamp per annum.	Total C. P. hrs. per annum.	Cost per C. P. hr.
Buffalo, N. Y.....	$127.75	8,132,000	.00157 cts.
South Norwalk, Ct.	60.00	3,461,000	.00173 cts.

So that in fact even in this favorable case of comparison for municipal plant, it costs ten per cent. more than the private plant does for the same amount of light.

GEORGE W. COLLES, JR.

HOBOKEN, N. J.

LITERATURE.

Elementary Lessons In Electricity and Magnetism. By Prof. S. P. Thompson, F. R. S. New York. Macmillan & Co. 1895. Cloth. 628 pp. 297 Cuts. Price, $1.40. (Fifth Edition).

One more welcome edition of this invaluable text book and manual, revised, extended, brought up to date, and its facts seen from the latest "point of view." No student wastes his time who masters this admirable exposition of the art and science of electricity. Few elementary works continue so fresh, strong and accurate as this, and its popularity through many years is sufficient evidence of its enduring merit.

The Telegraphist's Guide to the New Examinations in Technical Telegraphy. By James Bell, A. I. E. E. London, 1894. "Electricity." 101 pp. 5 x 7. Flexible cover. Price, 60 cents.

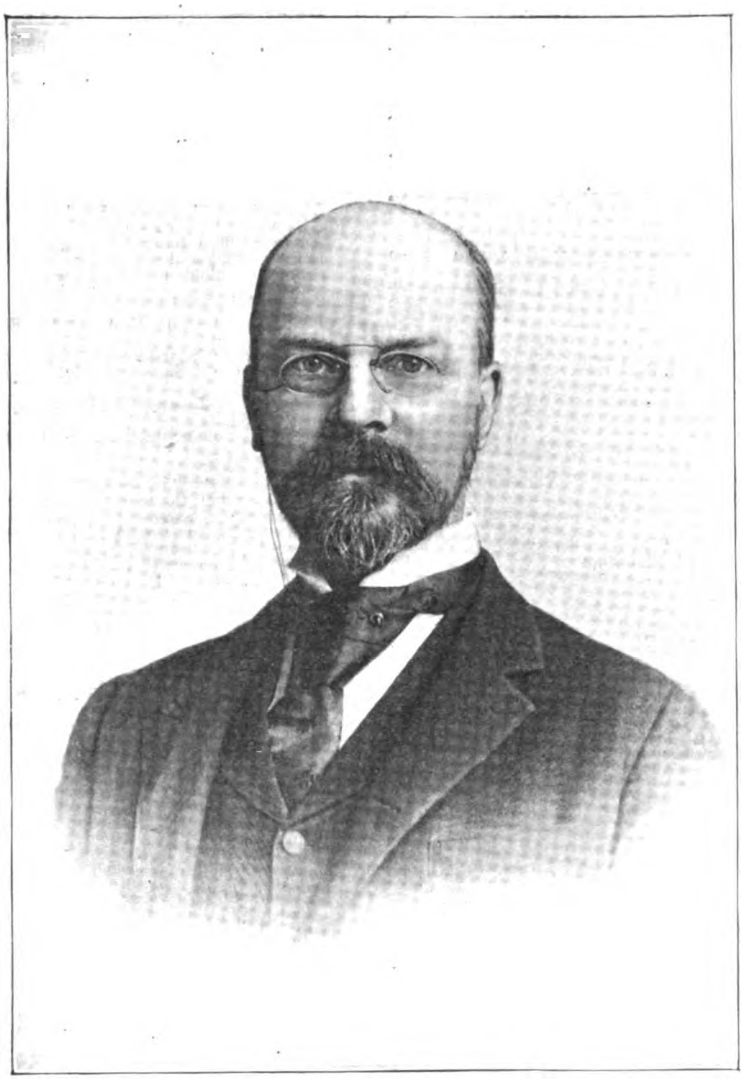
THIS is a reprint of a series of articles which have appeared in our London contemporary, *Electricity*, and which are designed to assist candidates for promotion in the Postal Telegraph service. The subject is treated from an eminently practical standpoint and embodies the manipulation of circuits, the testing out of faults and the various methods of working single needle, Wheatstone, the ordinary Morse and quadruplex, together with other information of analogous character. The work will prove useful to all engaged in this class of work. The illustrations are very clear and helpful.

OBITUARY.

GEORGE M. PHELPS.

SELDOM has death occurred with more sudden stroke than in the case of Mr. George M. Phelps, president of THE ELECTRICAL ENGINEER. He was at the office of the journal on April 6, busily occupied with his duties, but suffering from a cold which kept him at home the following Monday. His associates attached no importance to it, but pneumonia set in swiftly and they, with a host of other friends, were dumbfounded to learn that he had succumbed to the disease on Thursday afternoon. So unexpected was the occurrence, Mr. Phelps had taken absolutely no steps to make any wishes known in regard to a single matter, although he was always a man of marked care and method in all his affairs. His family and those near to him feel as though a cruel catastrophe had visited them, inflicting grief that is almost too deep for utterance.

Mr. Phelps was born at Troy, N. Y., in 1848, and received there a public and high school education, which he supplemented by continuous study through life. In 1861 he became connected with electrical interests in the shops of the American Telegraph Co., of which his father was superintendent up to its absorption by the Western Union Co. in 1866. It will be remembered that the senior Phelps was one of the distinguished and successful inventors in the first telegraph group—a worthy companion of Morse, Vail, Bain, Hughes and House, and one whose work still stands in the Phelps ticker, Phelps telephone, Phelps printer and other apparatus. The son closely resembled the father in a love of beautiful mechanism and in a fine sense of accuracy and finish in the construction of electrical devices. From 1871 to 1879 the two were associated in the conduct of the Western Union factory in New York, and when the latter shop was given up, Mr. G. M. Phelps, Jr., was appointed superintendent of the New York factory of the Western Electric Co., a position he held until December, 1885. Early in 1886 he joined Mr. Franklin L. Pope, an old friend, in the conduct of *The Electrician and Electrical Engineer*, then published monthly. He took so kindly to electrical journalism that he acquired a proprietary interest in the property. When in 1890 THE ELECTRICAL ENGINEER was expanded into a weekly and its business was incorporated, he was unanimously elected its president. He filled that capacity down to the day of his death, taking the most active part in the business management of the paper. Besides this he was a frequent contributor to its editorial pages, rendering invaluable literary and technical service. Of many questions he was an easy master, and his judgment was at all times sound and keen.



GEORGE M. PHELPS.

But Mr. Phelps never allowed business to absorb all his energies. He took an enthusiastic interest in the American Institute of Electrical Engineers; indeed its affairs might be called a passion with him, and never did a society enjoy more steadfast, loyal and disinterested service than he gave it. He was a charter member of 1884, and became a manager of it in 1885. In May, 1887, he was elected treasurer, and he had been re-elected to the office every year, being nominated by the Council also for 1895–6, on a far larger number of preliminary ballots than were registered for any other candidate or office. To these duties Mr. Phelps gave his unvarying conscientious attention, and he served moreover from time to time on several committees.

Club life was a social element that always had strong attractions for Mr. Phelps. He was treasurer of the old New York Electric Club, but had declined to stand for the presidency. He was also a veteran member of the well-known Hamilton Club, Brooklyn; and of the Reform Club, New York. The political work of the latter he followed closely, and lent his untiring support to its campaigns for honest money, a pure civil service and a low tariff.

As was natural from so long a connection with the electrical field, Mr. Phelps's circle of acquaintance was conterminous with the science and industry. With many leading American and English electricians, he was on terms of intimate and confidential relationship. No one will ever know the number of the struggling and unfortunate to whom he gave friendly advice and substantial assistance. They were legion, but he was a reticent man, and little inclined even to hint at his good deeds. One of the last things he did was to take up the cause of a little newsboy, who had been beaten by a big well-dressed bully. He brought the offender to justice by his own endeavors and secured a solid compensation for the poor lad.

The tastes of Mr. Phelps were highly intellectual. He had collected a library which though not large in the modern sense, was singularly well chosen, and was rich in the best modern essayists, as well as in works on political economy and science. Outside of books, his leisure was chiefly given up to music. He was a performer of a large repertory of classical piano music, and for years had hardly missed a first-class concert in New York or Brooklyn. One busy summer he remarked laughingly that he did not care about a vacation if he could only take in the seaside Wagner concerts given by Seidl.

The series of bereavements through which Mr. Phelps had passed within the last few months, depriving him of wife and mother, at short intervals, had thrown a cloud of depression over his sunny cheerful nature, and the recent serious indisposition of an only sister had been a burden under which many men would have been less patient and enduring. But his disposition remained serene, and the last conversation in which he took part in his office was marked by a most confident and sanguine attitude toward the returning conditions of general and special prosperity and the holiday he soon would take as a little reward for hard work. That a long rest awaited him so soon was perhaps the thing that he and those with whom he had stood manfully shoulder to shoulder, least dreamed of. But these are the surprises of Providence that pass mortal understanding.

The funeral services took place in the old home on Division Avenue, Brooklyn, on Saturday evening, April 13, and the interment took place the Monday following at the cemetery, Troy, in the family lot, the body being cremated. Both ceremonies were very largely attended, the American Institute of Electrical Engineers being also officially represented at the funeral. Several representative electrical journalists also were present to pay their last respects to one whom they honored in all his relations with them. Mr. Phelps left one daughter, the wife of Mr. George Wallace Graham, of Brooklyn. The bereaved family is in receipt of many expressions of esteem and regret.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 9, 1895.

Alarms and Signals:—

Police Signal Apparatus, W. H. Kirnan, Bayonne, N. J., 537,161. Filed Dec. 28, 1892.
Provides means for the ringing of the emergency bell in police signaling apparatus.
Railway Signal, H. E. Boothby, Chicago, Ill., 537,368. Filed Nov. 30, 1892.

Conductors, Conduits and Insulators:—

Insulating Compound, A. C. Thompson, St. Louis, Mo., 537,321. Filed July 30, 1894.
Consists of alcohol, gum shellac, pulverized asbestos, pulverized French chalk, balsam tolu gum, and ground mica in the proportions specified.

Distribution:—

Electric Battery System, A. J. Powell and W. H. Hall, Brooklyn, N. Y., 537,358. Filed Nov. 13, 1894.
Combines with a storage battery a primary battery; the latter is automatically switched in when the motor is cut out.

Dynamos and Motors:—

Ventilating Apparatus for Dynamo Electric Machines, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville, Mass., 537,010. Filed Dec. 7, 1892.
Directs a current of air through and parallel with the adjacent surfaces of the armature and magnet.
Traversing Apparatus for Commutators, J. Pease, Apperley Bridge, Eng., 537,354. Filed July 28, 1894.

Electric Metal Working:

Electric Metal Heating Process, G. D. Burton, Boston, Mass., 537,004. Filed Dec. 11, 1893.
Claim 1. The art of heating metal, which consists in submerging or partially submerging it in a bath consisting of an aqueous solution of carbonate of soda and borax, and then passing electric current through said metal and solution, forming an incandescent gas envelope or voltaic arc around its immersed metal.
Electric Bath Metal Heating Apparatus, G. D. Burton, Boston, Mass., 537,006. Filed Aug. 24, 1893.
The object of the invention is to provide means for the automatic connection and disconnection of the bars to be heated with the electric current on the withdrawal and insertion of the bars.
Method of and Apparatus for Electrically Heating Metal, G. D. Burton Boston, Mass., 537,007. Filed Jan. 23, 1895.
Consists in supporting the metal upon the surface of a non-conductive bed above the surface of an electrolytic bath, then shifting vertically the horizontal plane of one of said surfaces and bringing the bath and metal into electrical connection.
Electric Metal Heating Apparatus, G. D. Burton, Boston, Mass., & E. E. Angell, Somerville, Mass., 537,008. Filed Sept. 5, 1892.
The working circuits are so arranged in connection with the main circuit and the resistance that the latter will be automatically cut out while the work is being heated and thrown in when the work is withdrawn.
Method of and Apparatus for Electric Metal Heating, G. D. Burton, Boston, Mass., & E. E. Angell, Somerville, Mass., 537,009. Filed Aug. 30, 1892.
Relates to a closed forge for heating metals for forging and tempering purposes, to decrease the time and economize the power required for heating
Electric Bath Metal Heating Apparatus, G. D. Burton. Boston, Mass., & E. E. Angell, Somerville, Mass., 537,011. Filed Dec. 7, 1892.
The object of the invention is to provide means for quickly and properly handling the metal to be heated.
Electrical Welding Apparatus, G. D. Burton, Boston, Mass., & E. E. Angell, Somerville, Mass., 537,012. Filed Mch. 3, 1893.
Apparatus for electric welding, designed for rapid manipulation.
Apparatus for Brazing Metals by Electricity, G. D. Burton, Boston, Mass., & E. E. Angell, Somerville, Mass., 537,013. Filed Apl. 17, 1893.
The object of the invention is to provide means for the brazing of cast iron.
Machine for Closing Ends of Tubes, G. D. Burton, Boston, Mass., & E. E. Angell, Somerville, Mass., 537,014. Filed May 4, 1893.
Relates to the closing of the ends of metallic tubes and pipes, such as boiler tubes, gas pipes, water pipes and the like.
Electric Bath Metal Heating Apparatus, G. D. Burton, Boston, Mass., & E. E. Angell, Somerville, Mass., 537,402. Filed Sept. 5, 1892.
Claim 1:—A portable tank for heating metals provided with a porous partition and with a bracket at one side serving as a rest for the work or work-holder.
Apparatus for Electrically Heating Metal, G. D. Burton, Boston, Mass., 537,404. Filed Nov. 6 1894.
The object of the invention is to provide apparatus which will permit of the convenient handling of large pieces or bars of metal.
Apparatus for Electrically Heating Metal, G. D. Burton, Boston, Mass., 537,405. Filed Mch. 16, 1895.
Especially adapted for use as a forge for blacksmiths.

Electric Railways and Apparatus:—

Electric Railway Signal Apparatus, G. L. Thomas, Brooklyn, N. Y., 537,183. Filed Apl. 23, 1894.
Conduit Electric Railway, J. H. Guest, Boston, Mass., 537,194. Filed June 18, 1894.
Consists in suspending the conductor or the collector, or both, in a manner such as to provide for lateral movement thereof, and in combining therewith magnetic means of keeping them in electrical contact.
Conduit Electric Railway, J. H. Guest, Boston, Mass., 537,195. Filed Apl. 14, 1894.
Details of construction embodying automatic switches.
Supply System for Electric Railways, J. H. Guest, Boston, Mass., 537,196. Filed June 18, 1894.
Relates to means for controlling the operation of the switches, and is designed particularly as an improvement upon those plans wherein an actuating magnet on the car operates upon an armature connected to the switch on the permanent way.
Supply System for Electric Railways, J. H. Guest, Boston, Mass., 537,197. Filed Nov. 3, 1893.
Electric Railway, J. H. Guest, Boston, Mass, 537,198. Filed Aug. 9, 1894.
Provides means whereby, when a motor is taking current from a working conductor at one part of the system, the supply to a working conductor at another point whether on the same or a crossing or branch line is automatically cut off.
Electric Railway Supply System, J. H. Guest, Boston, Mass., 537,199. Filed Feb. 20, 1894.
Details referring to a system in which the contact to the sectional conductors are made by magnets carried by the car.
Closed Conduit Electric Railway, J. H. Guest, Boston, Mass., 537,200. Filed April 10, 1894.
A magnet on the car operates the switches.
Cut-off or Safety Attachment for Electrical Conductors, J. Parkinson, M. Springfield & C. Mills, Philadelphia, Pa., 537,238. Filed Oct. 10, 1894.
Trolley, Z. T. Furbish & G. A. Staples, Augusta, Me., 537,283. Filed Sept. 25, 1894.
Closed Conduit Electric Railway, J. H. Guest, Brooklyn, N. Y. 537,414. Filed Feb. 17, 1893.
Supply System for Electric Railways, J. H. Guest, Boston, Mass., 537,415. Filed July 6, 1893.
Supply System for Electric Railways, J. H. Guest, Boston, Mass., 537,416. Filed Oct. 12, 1894.

Electro-Metallurgy:—

Art of and Apparatus for Electrically Smelting Ore, G. D. Burton, Boston, Mass., 537,005. Filed April 26, 1894.
The invention consists principally in smelting ore by subjecting it to the action of a stream of a suitable watery liquid, which constitutes a part of an electric circuit, the electric current being of such a character that a voltaic arc is formed between the ore and the liquid.
Process of Amalgamating and Separating Metals, H. M. Baker, Brooklyn, N. Y., 537,330. Filed June 22, 1894.
Consists in mixing with the gold or silver containing sand or other material an amalgam of quicksilver and iron, which amalgamates with the gold or silver, and then drops the material through a magnetic field which deflects the mineral into one pile and permits the tailings to drop into another pile.
Apparatus for Recovering Precious Metals from Their Ores, F. H. Long & D. C. Skaden, Chicago, Ill., 537,423. Filed April 16, 1894.

Galvanic Batteries:—

Electrode, H. T. Barnett, London, Eng., 536,996. Filed Dec. 27, 1893.
Relates to that class of electrodes, in which the active surface consists of numerous fine filaments projecting from a suitable conducting base. Employs carbon filaments produced from cotton, or other vegetable fibres or from celluloid or other carbonizable material.

Lamps and Appurtenances:—

Incandescent Lamp, C. A. Merritt, Birmingham, Ala., 537,058. Filed Sept. 17, 1894.
An electric incandescent lamp having two or more connecting wires to attach to the carbons by which two or more carbons can be placed in the same lamp.
Incandescent Lamp Base, W. C. Bryant, Bridgeport, Conn., 537,271. Filed Dec. 20, 1894.
A strong and incombustible base of the Thomson-Houston type.

Measurement:—

Electrical Indicator, E. H. Johnson, New York, 537,118. Filed Oct. 1, 1891.
Connects with the moving portion of the amperemeter an air-dash-pot, the plunger of the dash-pot being preferably connected with the spindle carrying the indicator needle in such a way that a reciprocating movement is communicated to the plunger.
Electrical Measuring Instrument, E. Hartmann & W. Braun, Bockenheim, Germany, 537,343. Filed Nov. 27, 1891.
Has for its object to sum up the bendings produced in the heat-wires or connecting pieces, by the passage of the electric current, and thus to produce a large translation upon the axle of the indicator.

Miscellaneous:—

Electric Clock, F. L. Gregory, Chicago, Ill., 537,032. Filed Jan. 30, 1894.
Electrical Steering Gear, R. Noury, Nouveau Phalere, Greece, 537,124. Filed March 12, 1894.
An automatic steering device for keeping a perfectly straight course by the mariner's compass.
Demagnetizer, E. F. Gooding & G. W. Scovil, Elgin, Ill., 537,149. Filed Dec. 29, 1894.
Art of Extracting Grease from Wool, G. D. Burton. Boston, Mass, 537,403. Filed Oct. 31, 1894.
Subjects the greasy fibrous substance to the action of an electrolyzed solution.
Rheostat, J. C. Fyfe, Chicago, Ill., 537,412. Filed Jan. 24, 1895.
Adapted especially as a starting box for motors.

Switches and Cut-Outs:—

Arc Rupturing Device, E. A. Sperry, Cleveland, Ohio, 537,130. Filed Oct. 16, 1894.
An arc rupturing device, consisting of a magnet, one of the poles of which is at or near one of its ends, the said end constituting an arcing electrode.
Non-Arcing Switch, A. Wurts, Pittsburg, Pa., 537,259. Filed April 14, 1893.
Claim 1. In a switch, a stationary contact, a movable contact and a series of extinguisher bars in proximity to these contacts, composed of non-arcing metal.

Telephones:—

Telephony, E. F. Frost, Washington, D. C., 537,282. Filed Dec. 20, 1894.
The invention consists in the combination in a telephone system with the microphonic transmitter of an extra current or spark-coil.

PERSONAL.

MR. WILLIAM H. MCKINLOCK, president of the Metropolitan Electric Company, came East last week on business. He was accompanied by his family. Mrs. McKinlock, son and daughter left New York, Wednesday, April 10th on S. S. La Touraine for Paris, to be absent one year.

MR. A. P. TROTTER has resigned the post of editor of the London *Electrician*, and now proposes to devote his entire attention to his mechanical and electrical consulting practice, with offices at 28 Victoria St., London S. W., where his strictly professional work has been done since 1884. Mr. Trotter has no patents and no shares in any enterprise, and is absolutely free to devote his energies solely to the interests of his clents. He has a laboratory and gives special attention to photometric work.

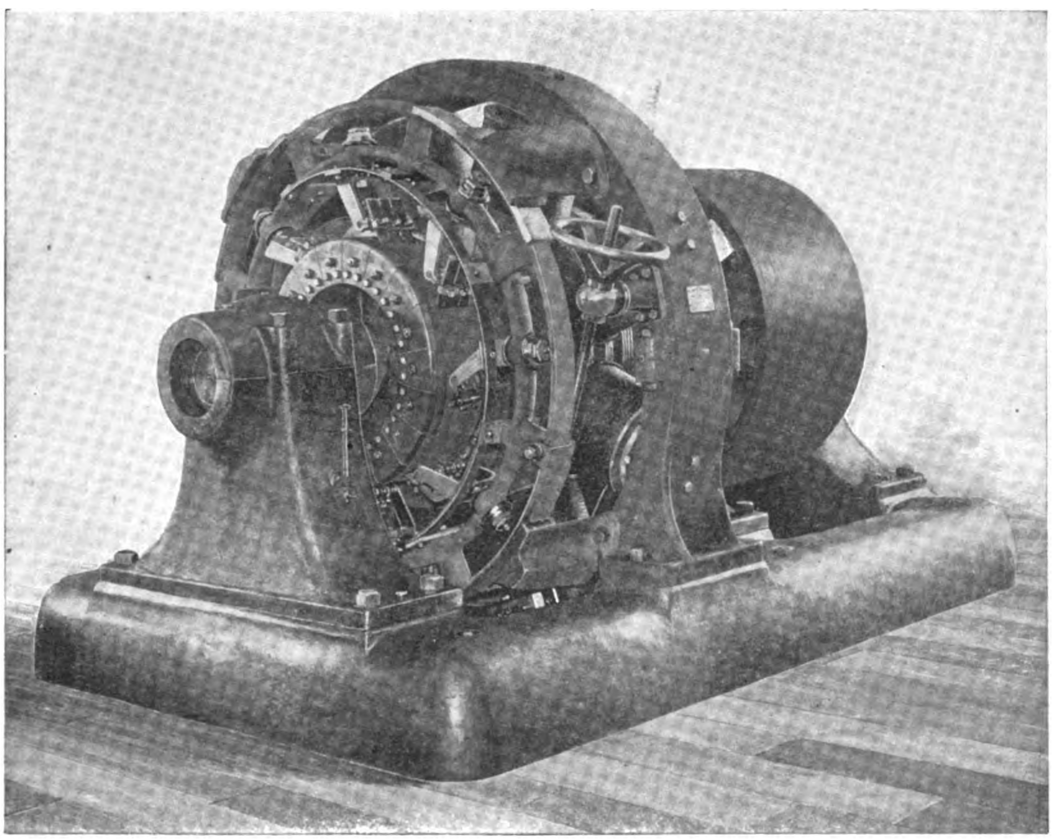
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

GENERAL ELECTRIC ELECTROLYTIC GENERATOR.

In the development of apparatus for use in electrolytic processes, the General Electric Company has attained the same degree of perfection as is characteristic of its apparatus employed in other branches of the electrical art; but, such is the dissimilarity of all electro-chemical processes, the design of a standard series of generators for electrolytic purposes, as has been done for lighting and power work, has been out of the question. There are scarcely any two classes of electrolytic work for which the voltage and current out-put are similar, and, consequently, the design of the dynamo employed has to be adapted to the special local conditions under which each process is carried out. In electrolytic work the general conditions require a machine with a heavy current output and a low voltage, one that may be relied upon to run continuously with no more attention than can be given to it when in motion, and one that will maintain the current constant, even with wide variation in the external resistance.

Our illustration shows a 200 K. W. generator which has been recently constructed by the General Electric Company to meet these special requirements. It is an eight-pole dynamo having a smooth core armature of laminated iron carrying machine-wound coils of copper cable. These are so adapted as to admit of ready replacement in case of injury. The bearings are self-aligning and self-oiling. The commutator shell is divided into sections allowing of the removal of segments without removal of the commutator or disturbance to other segments.



THE G. E. 200 K. W. ELECTROLYTIC GENERATOR.

The excellence of the armature ventilation and the low current densities in the windings, brushes and commutator, render this type of machine extremely cool running even under full load for a long period. It does not spark at the commutator, the life of which is, moreover, increased by the extreme depth of the segment.

The generator in question was designed to give 200 kilowatts under a wide range of voltage without material change in its structure. At 300 revolutions it gives a current of 1,330 amperes at 150 volts. A larger generator of similar type is now under construction for an out-put of 8,600 amperes at 75 volts and 280 revolutions.

Electrolytic apparatus manufactured by the General Electric Company can now be found in almost every electrolytic establishment in this country.

ASBESTOS INSULATED WIRE.

A new process of insulating wire with asbestos recently patented by Mr. L. W. Downes, of Providence, R. I., promises to do away with a great deal of the trouble which has been so generally experienced in the burning out of coils in electrical machinery. By this process the thickness of the covering is reduced to a point which compares very favorably with the double wound cotton, the insulation in sizes from No. 18 to No. 12 B. & S. being .016 inch, and from No. 11 to No. 2 being .018 inch.

A sample card was recently sent out by the inventor, exhibiting the heat resisting qualities of this new wire. Upon it was shown a sample of the finished wire having a smooth, even coating, somewhat resembling leather, very dense, and so tough that it is only with the greatest difficulty that any impression can be made upon it. Exhibit No. 2 shows a piece which has been joined to a sample of ordinary double wound cotton and the two together then subjected to the action of a heavy current. The result is that the cotton is almost entirely burned off, leaving but a small charred particle at the extreme end while upon the asbestos absolutely no impression is made. Another sample is a piece that has been raised to a red heat, the covering, however, being in no way injured, but remaining apparently as smooth and flexible as before the test. In exhibit No. 4 is shown the result of increasing the current to such a point that the copper is actually melted inside the covering. Here again is demonstrated the peculiar properties of the material, as the covering, except at the immediate point of fusion, is uninjured and would be as serviceable as before.

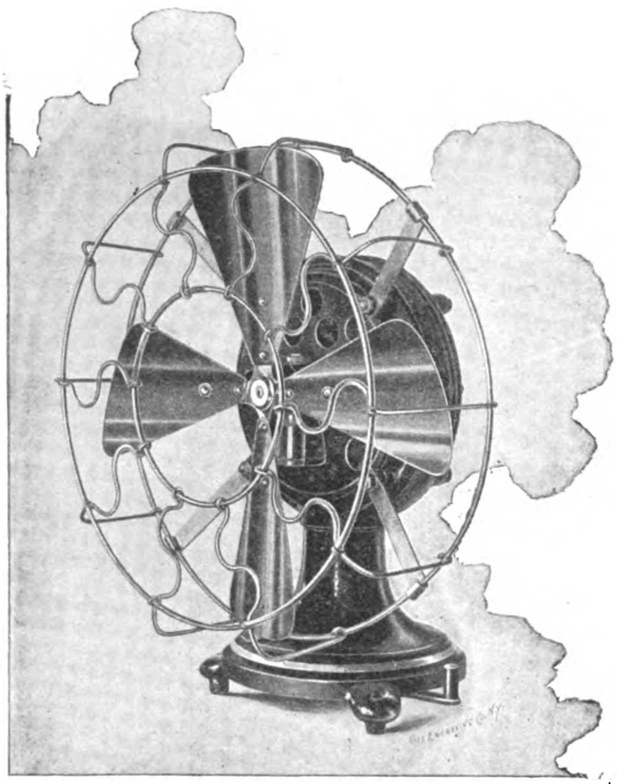
Tests made upon samples of this wire after they had been raised to a red heat, have shown an insulation resistance of over 95 megohms per foot. With an insulation resistance such as this, which is not affected by heat, it would seem possible to do away with the greater part of the insulating material at present in use, such as oil paper, linen, etc., thus saving space, reducing the cost of construction, and at the same time producing a coil which is practically indestructible.

A very extensive field of usefulness would at once seem to present itself for this wire, such as the winding of fields and armatures of railway and crane motors and all other types of apparatus that are subjected to continuous and severe strains with the resulting high temperatures.

MADISON, IND.—The Madison Telephone Company has been formed by John W. and Allison Scott, Edward A. Marks, Isaac H. Taylor and others.

LUNDELL ALTERNATING FAN MOTOR OUTFITS.

The demand for an alternating fan motor as attractive as the Lundell direct current fan motor, is now met by the latest production of the Interior Conduit and Insulation Company. In appearance the Lundell alternating fan motor outfit which we herewith illustrate, presents a beauty of design and finish equal to that of the direct current outfit, having a cylindrical field-magnet on a hollow cast-iron base. It is designed in two types, high frequency (14,000 to 16,000 alternations per minute) and low frequency (7200 alternations per minute) at 52 and 104 volts. Tests of the high frequency motors show that a current of 1.8 amperes at 52 volts with 12 inch fan is a fair average for their operation.



THE LUNDELL ALTERNATING FAN MOTOR.

Like the Lundell direct current motors these fans are superbly finished in rich black japanning with gilt stripings. All outside brass fittings, fans and guards are either polished brass or nickel plated. Self oiling and self-aligning bearings and a regulating switch giving three speeds are also features.

These motors are manufactured under the patents of Mr. Robert Lundell, its electrical engineer, by the Interior Conduit and Insulation Company of New York City.

PHILADELPHIA NOTES.

SMYRNA, PA.—The running expenses of Smyrna's electric light plant last year were $1,500 more than the receipts.

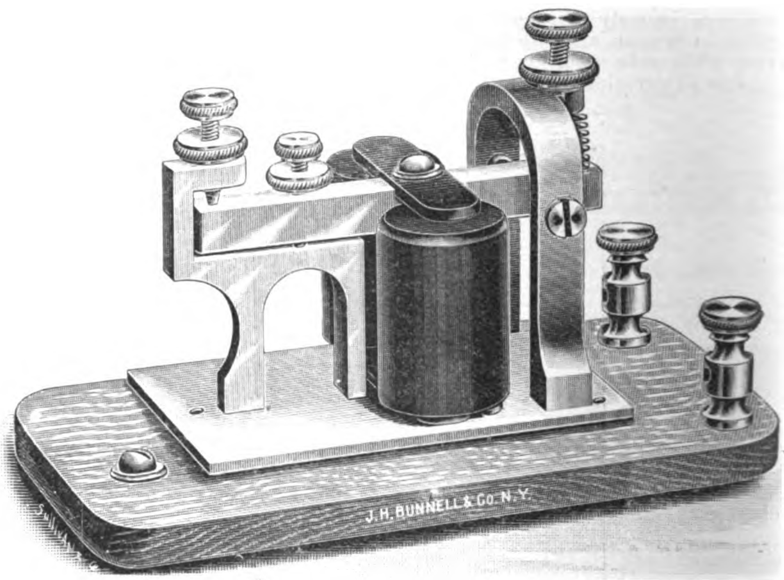
THE CHELTENHAM ELEC. LT., HT. & PR. CO. Oak Lane, Station A, Chas. W. Asbury, president, are negotiating for an increase in capacity and will install a 150 K. W. generator to run at 1000 volts; a 200 H. P. compound high speed engine and a condenser to match.

F. E. BAILEY & CO., who for a number of years have represented the Harrisburg Foundry & Machine Works (Ideal engines), in Philadelphia, and vicinity, have moved from 701 to 913 Betz Building, and are now representing the Armington & Sims Engine Co., of Providence. Their territory extends over quite a number of states and judging from the former success they have had, their prospects are very good for a large portion of first class engine and boiler business.

THE LUKENS IRON & STEEL COMPANY, Coatesville, Penn., who make a specialty of the Huston patent boiler brace, mention they have recently received an order for 6,000 tons of open hearth steel plates to be used in the construction of the cantilever bridge across the East river at Blackwell's Island, New York City. They have also received large orders for boiler steel from Cramp & Sons, the Philadelphia shipbuilders, for the new Clyde Line steamship, and from the Penna. Railroad Company, the Lehigh Valley Railroad Company, the Schenectady Locomotive Works and others, for boiler and fire box steel.

THE BUNNELL ALUMINUM SOUNDER.

THE well known and familiar Bunnell telegraph sounder with its sound amplifying base seemed to be so near perfection that improvement might well have been thought impossible; and yet a marked advance in the power of this sounder has just been effected by the application of aluminum in its construction. By employing an aluminum lever with its great resonating properties combined with the Bunnell base, the loudness and clearness of the click has been greatly augmented. It will also be observed that the adjustable trunnion thumb screws have been replaced by non-adjustable trunnion screws. These are made accurately to gauge and when screwed up give just exactly the proper bearing for the trunnions and obviate all trouble from binding due to the carelessness of operators. The lightness of the lever together with the superior winding and general construction of the apparatus makes one cell of gravity battery amply sufficient for its perfect operation. At the lowest calculation the maintenance of a gravity cell amounts to one dollar per year; thus the saving in local batteries, by the use of this sounder, is an important item to telegraph and railroad companies.



THE BUNNELL ALUMINUM SOUNDER.

NEW YORK NOTES.

MR. J. DAWSON, of Princes' Street, Wellington, New Zealand, will be glad to receive price lists of American supply houses.

THE MULTIPHASE MOTOR CO. of New York has been formed by A. S. Brown, W. D. Schramm and G. W. Gardanier with a capital stock of $200,000.

NEW ENGLAND NOTES.

THE NEWTON & BOSTON STREET RAILWAY COMPANY, of Newton, Mass., will extend their line 2½ miles and build a new iron or brick car house. Address L. H. McLain, superintendent.

HARTFORD, CONN.—The new boiler house for the Hartford Gas Light Co., Gen. John P. Harbison, General Manager, at Hartford, Conn., has been completed by the Berlin Iron Bridge Co., of East Berlin, Conn. The roof is anti-condensation.

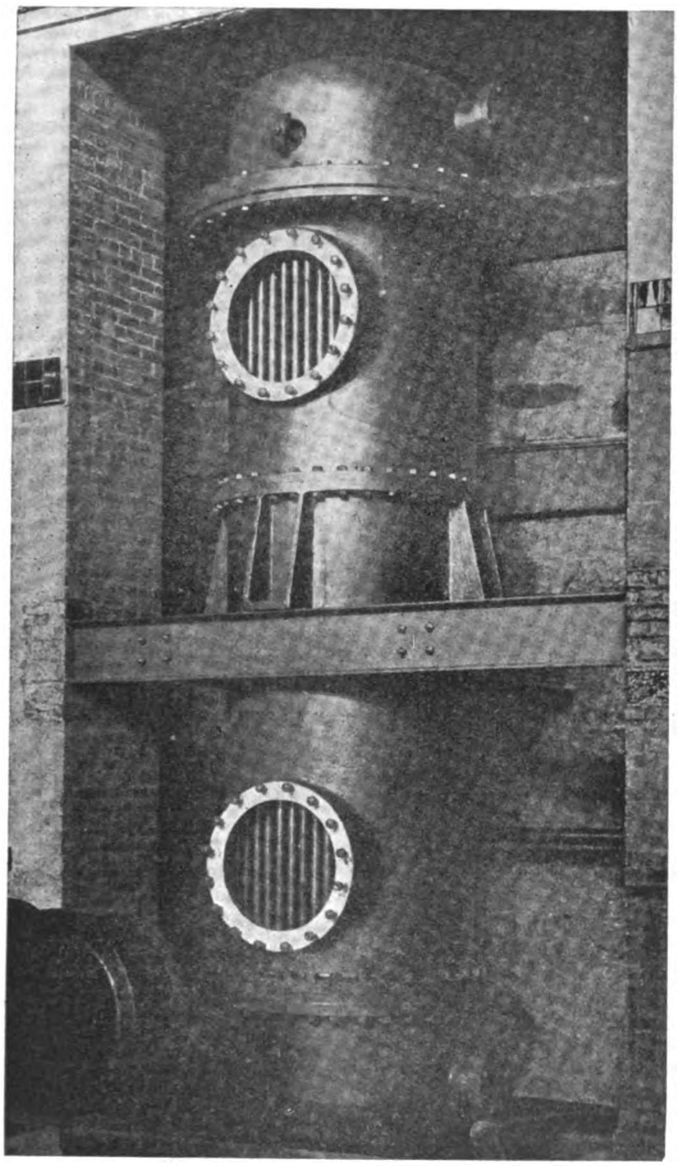
THE MATHER ELECTRIC COMPANY, of Manchester, Conn., have just closed a contract with the Berlin Iron Bridge Company, East Berlin, Conn., for equipping their new forge shop with electric power. A 40 K. W. generator and a 50 H. P. motor will be used.

THE COLLINS CO., of Collinsville, Conn., are putting up a new retort house which will be of iron, designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn. The new Capitol Ave. bridge at Hartford, Conn., will be built by the Berlin Co., and will consist of two span plate girder, each 82', with a roadway 25' in width, and two sidewalks.

BOSTON MAIL TROLLEYS.—The city of Boston is to have a complete trolley car postal service covering 390 miles of street. There will also be three special mail cars and four compartment cars. The service will begin on May 1, and then many of the existing horse mail carts will be abolished.

A 4,000 HORSE POWER GOUBERT HEATER.

The Goubert Manufacturing Company, of 14 and 16 Church St., New York City, have recently installed at the First District Station of the Edison Electric Illuminating Company in Pearl street, Brooklyn, N. Y., a 4,000 H. P., vertical Goubert feed water heater. A good view of this immense heater, one of the largest ever built, is shown in the engraving on this page. It is a most perfect piece of work and designed expressly to fit into the limited space available. The heater is made entirely of cast iron and brass, and is of the latest improved Goubert type with curved upper and lower tube plates and patent flexible expansion joint. This is the only joint in the heater that is not rigid, the differential expansion between the shell and the brass tubes being taken care of at this point. The Goubert heater is especially desirable in connection with large plants doing heavy duty, in fact it is said to be the only one made for the high pressures that are now so frequently used. The Goubert Manufacturing Company is doing an extensive business in large units, especially for electric plants, both lighting and traction, operated by the principal companies throughout the country.



A 4,000 HORSE POWER GOUBERT HEATER.

THE NEW FERRACUTE CATALOGUE.

The Ferracute Machine Co., of Bridgeton, N. J., have issued their new 1895 catalogue, "No. 11," illustrating new designs of foot and power presses, lathes, beaders, dies, etc., for working bar and sheet metals. The catalogue is very full. It contains 82 large pages and describes 300 sizes and kinds of presses, many of which are illustrated.

Some of these presses are run by electric motors built into the frame of the machine. An illustration of one of these presses is shown on page "12½" of the catalogue. These presses are all well built and adapted for long, hard service. They have carefully scraped working surfaces and are provided with all the refinements of the best modern practice. The catalogue will prove valuable to manufacturers.

AFFAIRS OF THE MATHER ELECTRIC CO.

The following notice is self explanatory:

OFFICE OF CHARLES M. JARVIS, RECEIVER,

The Mather Electric Company,

MANCHESTER, CONNECTICUT, April 6, 1895.

Dear Sir:—

Owing to the inability to collect accounts due, The Mather Electric Company has this day been placed in the hands of a Receiver. The undersigned has been appointed by the Superior Court of Hartford County, State of Connecticut, as Receiver in charge of all property of every name and nature belonging to the said Company. As soon as possible a statement of the assets and liabilities will be made and forwarded to you.

By order of the Court the Company is allowed to proceed with the manufacture of electrical apparatus in order to close out the large amount of machines and material now on hand, nearly all of which is already sold. It is hoped that the receivership is but temporary, but an inventory is now being taken and as soon as completed all creditors will be fully informed as to the exact condition of affairs.

All material in the shape of supplies received by the Company after 10:10 A. M. on Saturday, April 6, 1895, will be paid for by the Receiver. Material and supplies received before that time will be credited on the accounts of The Mather Electric Company.

This is signed by Mr. Jarvis, of the Berlin Iron Bridge Co. The Company continues in active business.

NEW SALES OF WALKER APPARATUS.

The Walker Manufacturing Co., Cleveland, Ohio, have closed the following contracts since April 1st, 1895, all for speedy deliveries, which will show the popularity which their improved generators and motors are gaining. Their shops are now running both day and night: St. Charles Street Railroad Co., New Orleans, La., 3 200 K. W. direct coupled generators; Corning & Painted Post Street Railway Co., Corning, N. Y., 2 125 K. W. direct coupled generators; Messrs. Channon & Wheeler, Quincy, Ill., 1 75 K. W. belted power generator; Manhattan Beach Hotel & Land Co., New York City, 1 60 K. W. belted lighting generator; Norfolk & Ocean View Railroad Co., Norfolk, Va., 2 250 K. W. belted generators, 3 double car equipments, six 50 H. P. steel motors, 2 double car equipments, four 30 H. P. steel motors; E. A. Darling, sup't Columbia College, New York City, 1 50 K. W. belted lighting generator; Buffalo, Kenmore & Tonawanda Electric Railway Co., Buffalo, N. Y., 2 double car equipments, four 25 H. P. steel motors; Stern & Silverman, Philadelphia, Pa., for Rapid Railway Co., Detroit, Mich., 2 200 K. W. belted generators, 8 double car equipments, sixteen 50 H. P. steel motors; Dunkirk & Fredonia Railroad Co., Fredonia, N. Y., 1 double car equipment, two 25 H. P. steel motors; Schenley Park & Highlands Railway Co., Pittsburgh, Pa., 3 double car equipments, six 30 H. P. steel motors. There has also been a marked increase in their orders for general work as well as electrical work.

NEW ENGLAND NOTES.

THE NATIONAL TELEPHONE MANUFACTURING CO., of Boston, are having an unprecedented success with their latest production, the "Pony National" well illustrated this week in our advertising columns. This instrument is fitted with a compound receiver, granular carbon battery transmitter, and either a buzzer or polarized bell for signals, and has the sensitiveness of a "Blake" instrument with the power of the "Solid Back." It is an extremely valuable instrument for all local service, whether for interior or exchanges, and has been very largely adopted, as representing the highest state of the art in telephony of to-day. Recently the Topeka Harrison Telephone Co., of Topeka, Kan., organized some time ago to exploit the Harrison instruments, ordered some 300 of these Pony telephones, and have now about 200 in successful operation, and are eminently well satisfied with the result. This is sufficient recommendation for the instrument, and ought to arrest the attention of every one thinking of adopting some telephone system, before concluding any new contract.

THE STANDARD THERMOMETER CO. of Peabody, Mass., are putting on the market their new Upton arc lamp for series incandescent and alternating current circuits, which, judging from its appearance and tests, should speedily become a favorite. It possesses the virtue of extreme simplicity, and probably has fewer working parts than any other lamp in the market, and can be sold at extremely reasonable prices. The direct current lamps, are made to burn 11 or 14 hours, are cheap to buy and maintain, and should be investigated before ordering elsewhere. This company are the original manufacturers of the Simplex, Ward and Knight lamps, and have had years of experience in this class of work. Mr. Charles A. Bramhall, is their selling agent, with headquarters at 39 Cortlandt St., New York.

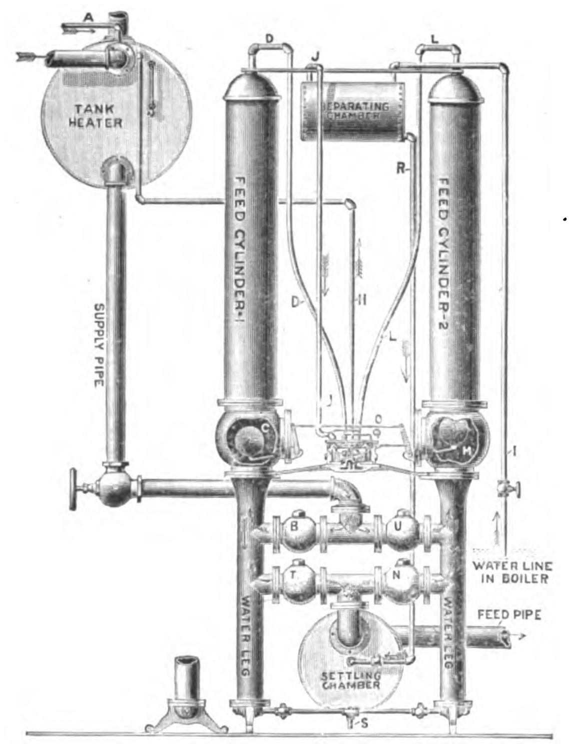
THE AUSTIN AUTOMATIC BOILER FEEDER, PURIFIER AND HEATER.

The accompanying engraving represents the Austin automatic boiler feeder, purifier and heater which has been designed to feed boilers without the use of pump or other boiler feeding device, and at the same time maintain a positive water-line in the boilers at all times, prevent scale formation and heat water with exhaust steam after which it is superheated as it passes through the feeder and purifying processes.

The action of the apparatus is exceedingly simple. As the water in the boiler lowers, steam passes up the steam and skimmer pipe I and starts the machine to feeding, but as the water in the boiler raises, the end of the pipe is closed and, the pressure being shut off, the machine stops, thus making the machine absolutely automatic in its operation.

The feed water is subjected to four various purifying processes. First, in the heater; second, as it stands in the feed-cylinders above the water legs; third, as it first passes through the settling chamber before entering the boiler, fourth, as that sediment which still remains is taken out of the boiler through the skimmer pipe I and deposited in the settling chamber.

The machine has been in operation for the past six years, but only within the past two years has it been put on the market. The manufacturers claim that it has been thoroughly tested in some of the worst scale producing water in the country, and



Austin Automatic Boiler Feeder, Purifier and Heater.

wherever tried it has been successful in preventing the formation of scale on the shell and tubes of the boilers.

It is claimed that the machine can be operated with one-fourth the steam that is required to do an equal amount of work with a steam-pump or one-sixth of that required by an injector. By having the feeder and purifier in connection, there is a double use made of the steam, as it is also used to produce a skimming current up the steam pipe which opens at the water-line of the boiler.

These machines are built by the Austin Automatic Boiler Feeder Co., of Marion, Ohio, in several different styles to suit the work required of them, but the general principle and operation is the same in all styles. The machine will operate on a battery of boilers as well as on a single one.

CHANGES IN THE BRUSH ELECTRIC CO.

Mr. Charles N. Black, E. E., has just been appointed superintendent of the works of The Brush Electric Company, of Cleveland, Ohio, in place of C. W. Phipps resigned. Mr. Black is a graduate of Princeton College. The last two years of his course were devoted to electrical engineering under Professor Brackett. As soon as he finished his college career, he took a trip through Europe and then entered the shops of The Brush Electric Company as an ordinary workman. He has had experience and supervision in every department of the extensive works. The design and construction of the large Brush arc dynamos Mr. Black had charge of and in connection therewith was thrown into frequent consultation with Mr. Brush. Mr. Black is eminently qualified for the superintendence of the manufacture of electrical apparatus.

THE PACKARD INCANDESCENT LAMP.

The Packard lamp has won for itself an excellent reputation but a graphical representation of its excellent qualities shows this in a way more convincing than any verbal argument. The properties of the Packard lamp are manifest from the curves illustrated in our advertising columns. These represent a test made on this lamp, and on three others, designated B, C and D. It will be noted that in all of the other lamps the candle-power dropped within the first 100 hours from 16 C. P., to 14, 13 and 11 candle-power, respectively, and continued to fall during the 800 hours. The Packard lamp, on the contrary, from the moment of starting, increased in candle-power from 16 to 19 during 300 hours, then gradually falling to 16 candle-power at 500 hours and continuing practically unchanged at its full candle-power up to the 800 hour limit.

VARIOUS SUPPLIES WANTED.

W. E. Sudlow & Son, of Florence, S. C., write us that they are about to install a system of arc and incandescent lighting, and are now on the market for engines, boilers, dynamos, and general electrical supplies. The plant will include 40 arcs and 500 incandescent lamps.

NEW YORK NOTES.

The Crocker-Wheeler Electric Co. have resumed work at their factory at Ampere, N. J., and are rapidly wiping out the traces of their recent fire. They have already begun to make shipments again, and are in close touch with their large Spring trade.

The Incandescent Lamp Manufacturers are reported to have had a conference in New York last week, at which the condition of the trade and the outlook were discussed. It is understood that they separated, well pleased with the prospects and prepared for an aggressive campaign.

The Habirshaw Wires and Cables. The India Rubber & Gutta Percha Insulating Co., have now given up their quarters at 315 Madison avenue, and have massed their New York selling forces and offices at 15 Cortlandt street. They have their headquarters at Yonkers, where the large factory is supremely busy, with a big amount of new work in sight.

Mr. N. M. Garland, who has been so successful as representative of the Meston alternating current motor for fan work and the Storey Motor & Tool Co. has taken new quarters at 112 Liberty street, where his large and growing trade will have an excellent opportunity for further rapid development. Mr. Garland sees lots of good business ahead in his admirable specialties.

Mr. R. B. Corey intends shortly to issue a catalogue of the Bergmann specialties. It will probably be ready for distribution in from ten days to two weeks, and will undoubtedly prove a valuable index to arc light material. Mr. Corey has met a flattering success since the occupancy of his new offices in the Havemeyer Building, notwithstanding the fact that but a short time has elapsed since he took possession.

WESTERN NOTES.

The Metropolitan Electric Company are finding very ready sales for their new carbon open circuit battery that they recently put on the market.

"The More We Use It, the Better We Like It," is what a customer writes to the manufacturer of the Allen soldering stick. Mr. Allen reports orders coming in at the rate of 2,500 sticks per day of late, which certainly speaks well for this valuable adjunct to the wireman's outfit.

The Bryant Electric Company has placed upon the market a weather proof socket with side connections and one with bottom wires, also an angle receptacle and a combination cleat which contains attachments for the fuse and drop cord. It has the well known Cleveland single pole switch, especially adapted for 500 volts, in stock. Grier Brothers, managers of the western office, have a complete line in the western store rooms at Chicago.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. APRIL 24, 1895. No. 364.

CHARLES AUGUSTIN DE COULOMB.

BY

Alfred M. Mayer

C. A. de Coulomb.

VERY few electricians have seen a likeness of Coulomb. Indeed, on inquiry, I found that probably no likeness of him exists in any of the collections of portraits of electricians made in this country. During the summer of 1891 I found a marble bust of Coulomb in the Conservatoire des Arts et Métiers, in Paris. My son, Alfred G. Mayer, made, in pencil, the profile of this bust, which is accurately reproduced in the accompanying engraving, from the original sketch.

To appreciate fully Coulomb, we must remember that before the date of his researches (1784–89) in electricity and magnetism these sciences could not be called *quantitative*. On his invention of *the torsion-balance*, founded on his discovery of the law giving the relation between the force required to twist a wire and the angle of torsion, Coulomb had in his hands an instrument which he used with consummate skill in his researches and which, in one form or another, has been used ever since in exact measures of electric and magnetic actions. Coulomb's torsion-balance was used by Cavendish in his memorable experiments which first gave the density of the earth, and quite recently the same balance, with the wire replaced by a fibre of quartz, has, in the skillful hands of Boys, given the most exact determination of the earth's density.

The nature, extent, and importance of Coulomb's discoveries with his torsion-balance may be best stated by giving the titles of his seven memoirs, which I have in my library.

First Memoir on Electricity and Magnetism: **By M. Coulomb (1785, 11 pages, 4to, with one steel plate).**

Construction and use of an Electric Balance, founded on the property of Metallic Wires having a force of reaction of Torsion Proportional to the angle of Torsion.

Experimental determination of the law according to which the elements of Bodies electrified with the same kind of Electricity, mutually repel one another.

Second Memoir: **(1785, 34 pages, 4to, with one steel plate). In which we determine, according to what Laws the Magnetic Fluid, and also the Electric Fluid, act, by Repulsion, also by Attraction.**

Third Memoir: **(1785, 29 pages, 4to, with one steel plate). On the quantity of Electricity which an isolated body loses in a given time, either by contact with air, more or less moist, or along supports more or less idio-electric.**

Fourth Memoir: **(1786, 11 pages, 4to, with one engraving). In which we Prove Two Principal Properties of the Electric Fluid.**

First, that this fluid does not spread on any body by a chemical affinity or by an elective attraction, but that it is divided between different bodies placed in contact solely by its repulsive action.

Second, that in conducting bodies the fluid, arrived at a state of stability, is spread over the surface of the body and does not penetrate in the interior.

Fifth Memoir: **(1787, 47 pages, 4to., with 2 steel plates.) On the manner in which the Electric Fluid Divides itself between Two Conducting Bodies Placed in Contact, and on the Distribution of this fluid on the Different Parts of the Surface of these Bodies.**

Sixth Memoir: **(1788, 91 pages.) Additional Researches on the Distribution of the Electric Fluid Between Several Conducting Bodies: Determination of the Electrical Density at the Different Points of the Surface of these Bodies.**

Seventh Memoir: **(1789, 51 pages, with two steel plates.) On Magnetism.**

In this memoir Coulomb gives the laws of magnetic attraction and repulsion; the moments of magnets of different lengths and diameters; the distribution of magnetic force along the magnet; the best form and temper to be given to steel magnets and on the manner of magnetizing steel bars.

Our readers no doubt take pleasure in reading the biographies of those whose labors have built, during so many years of conscientious, unselfish work, the beautiful fabric of our modern science of electricity. I refer them to an extended and excellent biography of Charles Augustin de Coulomb in Michaud's *Biographie Universelle*, Paris, 1854. There is also a short sketch of his life in the Encyclopædia Brittanica. The reader of the first-named biography of Coulomb will see how noble the man was; performing his duty in spite of ill health; his work unappreciated and unrequited; imprisoned rather than lend his honor and his talents to the jobbery of the ministry of the government, and finally, after years of unappreciated services, receiving as his just reward the respect of those who had condemned him, and the highest honors of his country.

STEVENS INSTITUTE OF TECHNOLOGY,
HOBOKEN, N. J.

PRACTICAL WIRING SPECIFICATIONS.

BY A. E. DOBBS.

SOME specifications given me by architects to estimate upon, are amusing to a practical man from the go-as-you-please manner in which they are drawn up. Many of them simply say that the building shall have a certain number of lights "to be wired according to the Board of Underwriters" or "one outlet for electric lights in the centre of each room" with three wires in the large room to come to side brackets.

About as definite as many of them get is to say that there "must not be a drop of more than two or three per cent." And when the building is finished the contractor turns on the various circuits *one at a time* and proves by his voltmeter that there is no drop at all. Perhaps an expert is called upon to witness the test, whose regular occupation is that of telegraph operator or bell hanger who takes the voltmeter at its face value; in fact he cannot do anything else for what does he know about the difference between full load and no load?

Architects frequently call upon contractors to assist them in preparing plans for lighting and many contractors readily do so in order to have a satisfactory set of plans upon to which to bid. But this is a thankless task and not always appreciated. Someone else is liable to get the

contract and all the credit for the work. Contractors do not like to be too specific as to details and give their rivals instruction as to their own methods and perhaps give the architect a weapon to use against themselves later. Then again architects are human and do not always know what they want themselves.

I also remember a case where a certain wire was specified and the builder would accept no other kind even though—as I could not procure the specified wire without considerable delay—I offered him a really better and higher priced grade of wire.

Perhaps the architect knowing that the owner will not be willing to pay for really first class work will nevertheless demand it in his specifications. So he proceeds to make up an elaborate plan that says much and means nothing except that the outlets shall be in certain places, copies a few extracts from the "Book of Rules" and requires that the work must be passed by that somewhat uncertain individual the insurance inspector.

Now the inspector would look after the rules in any case; the only use he has for the plans is to assist him in understanding the work. If he passes it, he cares nothing for the form of contract; if he condemns it, the contract makes no difference to him.

Some contractors will bid upon nothing but good work and trust to their reputation and standing to pull through against all opposition, but many are not so happily situated and must bid upon the specifications as they read, not as they would like to have them. This accounts for so much unsatisfactory wiring.

On very large contracts the owners now frequently employ an expert to draw up specifications and supervise the work. This is the most satisfactory method for the owners at least; but even electrical engineers in drawing specifications frequently fail to be explicit as to details. I have seen such, that seemed to be but little more than a rehash of underwriter's rules. Why should not specifications for electrical work be as clear and explicit as those for carpenters, masons and steam fitters?

When a set of building plans is laid before the electrical engineer he should study them as to walls, beams, etc., to find how he can get through the building to the best advantage. Then let him mark out centres of distribution having reference to convenience and economy of wire. A young graduate is liable to make mistakes at this point. Then he should decide upon the percentage of loss in the wiring; here again practical experience counts for much. A private residence, for example, will hardly ever carry a full load, and a three per cent. loss in feeders would not amount to more than one per cent. in actual practice, while many large buildings are liable to call on the various feeders for an extra supply even to the point of overloading them. Many large office buildings are seriously hampered in this way. Unless the building is a very large one the loss from the bus bars or main entrance to the lamps should not exceed two or three per cent. Of this the mains or risers take one-half the loss, leaving the balance to be taken up by the lamp circuits.

The specification should indicate just what size wire will produce this result. It is not a great deal of trouble to say that a No. 6 or No. 0 main shall be run to a certain place and it requires no very elaborate calculation to require lamp circuits to be run with No. 10, 12 or 14 wire, as the case may be.

Wiring tables are easy to get, so that one will not often be called upon to make one's own calculations. Then the specification ought to say where moulding shall be used, where conduit, cleats, etc., and lastly, an estimate ought to be made of the amount of wire, number and location of switches, cut-outs, outlets, etc. This will perhaps call for a little additional trouble, but it will make clear to contractors just what is meant and the uniformity of the bids will be surprising; but what is more important, the work will be satisfactory to the owners.

THE FIRST THREE-PHASE PLANT IN CANADA—THE STATION AT ST. HYACINTHE, P. Q.

The town of St. Hyacinthe, at which place is located the first three-phase plant installed in Canada, is on the Portland line of the Grand Trunk Railroad about thirty-five miles from Montreal. A branch line of the Canadian Pacific also reaches the town, and a new line of railway called the United Counties passes through it, connecting it with the town of Sorel on the west and Iberville on the south. The population, at present about 11,000, is rapidly increasing. A fine water power on the Yamaska River is utilized to operate the Granite Mills owned by Feodore Boas & Co., manufacturers of woolen goods, and several other factories.

There has been for some time, however, a demand for more power than was available in the town itself, and in the Fall of 1893 the transmission of power from the Rapid Plat, 4½ miles below the city, was first discussed. In February, 1894, this power was acquired by Mr. A. M. Morin and in April of that year a company called La Compagnie des Pouvoirs Hydrauliques de St. Hyacinthe, was formed to improve and distribute it for motive purposes and lighting in the town. Work was commenced at once on the water power and in July a contract was closed with the Canadian General Electric Company for the necessary electrical apparatus for the plant. A thorough investigation was made of the different systems of electrical transmission, and the president of the Company, Mr. Louis Cote, and their consulting engineer, Rev. Father Choquette, visited a number of power transmission plants before a decision was reached. The contract for the water wheels and shafting was awarded to the James Leffel Co., of Springfield, O., who also furnished plans for the installation of the wheels.

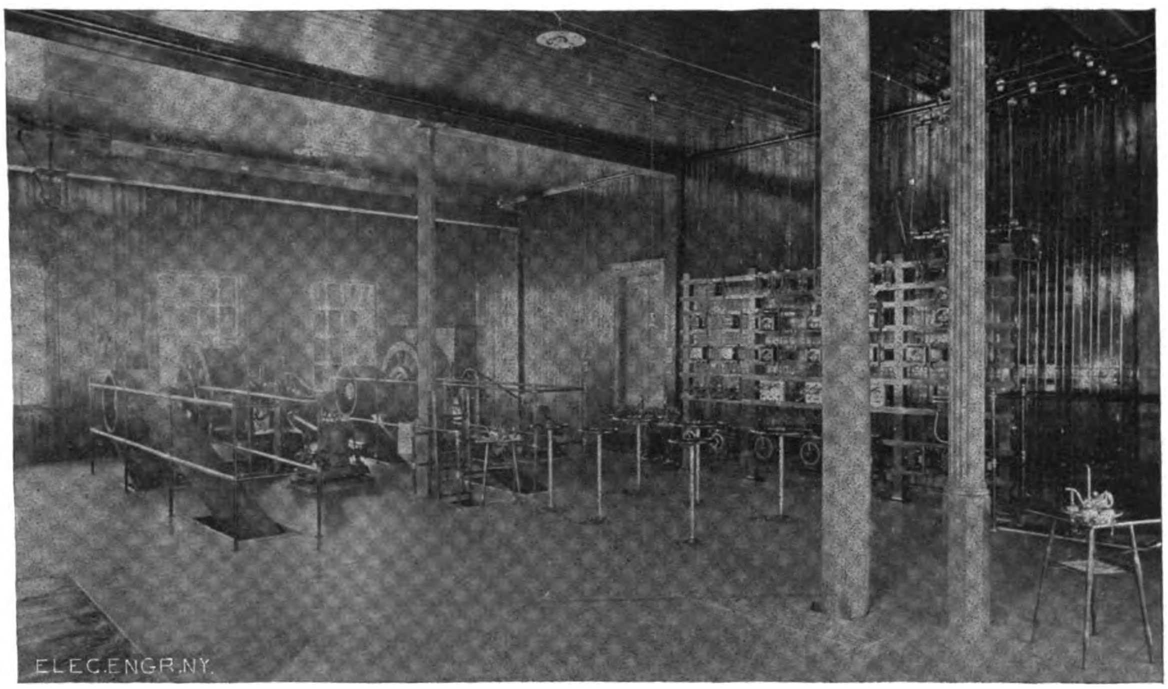
Water Power Plant.—The power had formerly been utilized for the operation of a grist mill and woolen factory on one side of the river and for a small grist mill on the opposite side. No change was necessary in the dam, although it will be possible by raising this to greatly increase the power available. The canal leading to the mill was almost entirely re-constructed and deepened so that its capacity is nearly three times that of the old canal. In addition to this a long tail-race was excavated, greatly increasing the head, which is now about 17 feet.

The water is led directly to the wheels which are four in number, of the Leffel Co.'s "Sampson" type, 50 inches in diameter and running at a speed of 100 revolutions per minute. These wheels are on vertical shafts and placed in wooden penstocks with separate gates. At the top of the vertical shaft is placed a crown wheel 6 feet 2 inches in diameter having 78 ironwood teeth. This is geared to a pinion $24\frac{3}{16}$ inches in diameter having 26 teeth, and connected to a horizontal shaft by means of clutch coupling. The shaft is divided into two sections connected by a Hill cut-off clutch, two wheels being geared to each section. The main driving pulleys which are four in number and each provided with Hill clutches are placed on an extension of this shaft under the dynamo room. Hand wheels controlling each of the four wheels and the four clutch pulleys, are placed in a convenient position in the dynamo room, so that the entire operation of the plant can be absolutely controlled from the switchboard. Two electric governors, one for each pair of wheels are connected to controlling mechanism, which is also placed in the dynamo room. It is intended to connect a tachometer to the shafting which will at all times indicate the speed.

Electrical Plant.—The electrical equipment of the power house, installed throughout by the Canadian General Electric Co. Ltd., consists at present of three of their type A. T. 12–150–600 standard three-phase alternators, each being of a capacity of 150 K. W. at 2,500 volts. They are compound wound in the same manner as that Company's

single phase high periodicity alternators of the Thomson-Houston type, the commutator, however, being in three sections to accommodate the three-phase current. The separate exciting current is supplied by two 6 K. W. standard Edison dynamos, either of which is capable of exciting the fields of all three machines.

The periodicity of these alternators is 60 cycles per second, this having been adopted in place of the old standard of 125 cycles, as it has been found from experience that motors operate very much more satisfactorily the lower the periodicity; and this number was decided upon as being more suitable for the combination of motors, arc lamps and incandescent lamps, the steadiness of the latter being affected when the periodicity is much further reduced. The current from these machines is led to the centre panel of the switchboard, as shown in the accompanying engraving, and is there connected to the main bus bars in multiple through three high potential triple pole switches. On this panel is also placed a current indicator and potential indicator for each machine, together with the phase indicator by which the machines are thrown together. The feeder panel is to the right and is equipped with three current indicators, one for each leg of the system, a ground detector, lightning arresters and feeder blocks. On the left are the three station transformers and the exciter current indicators and switches.



THREE-PHASE STATION AT ST. HYACINTHE, CANADA.

Line.—The distance between the power plant and the town as stated above is 4½ miles. The line consists of four No. 00 B. & S. bare copper wires placed on double petticoat insulators. The poles are all of cedar 30 feet in height above the ground, and a double set of cross arms, pins and insulators are placed on each pole. Only three of the wires are normally in use, the fourth being kept as a spare in case of accident. The line is of the most solid and substantial construction throughout and has been built with the object of providing amply for any addition to the circuits which may be required at any future time.

Secondary Distribution.—The primary wires are brought to the centre of distribution in the town, and from this point primary mains extend over the district which is to be furnished with light and power. The greater portion of the lighting is from a four-wire system of secondary mains fed by banks of transformers at suitable points. This system combines the economy of both the three-wire and three-phase systems and insures a uniform potential at all points. All large motors will be connected to separate banks of transformers, only the smaller sizes being operated from the secondary mains.

The Company.—The directorate of the company includes the names of nearly all the prominent business men of the town. Mr. Louis Cote, the president, is well known as the inventor of several important labor-saving machines for shoe manufacturing. Mr. Payan, vice-president, is a member of the firm of Duclos & Payan, tanners and manufacturers of leather. The construction work and wiring has been done under the supervision of Mr. R. Duperouzel, Supt. of the Hydraulique company, to whom much credit is due for the manner in which he has carried out an installation having so many novel features.

THE KORDA THERMO-CHEMICAL CELL.

At a recent meeting of the Paris Academy, M. Désiré Korda read a paper on a "thermo-chemical carbon cell." The author finds that if barium peroxide is heated to redness in contact with a carbon plate, the oxide becomes reduced to baryta, and a difference of potential of about one volt is produced, the carbon plate being negative. A similar result was obtained with cupric oxide as soon as a layer of potassium carbonate was placed between the oxide and the carbon, the difference of potential in this case amounting to 1.1 volts. The experiments were in each case performed by connecting a plate of gas-retort carbon by means of a platinum wire to one terminal of a Richard voltmeter, and placing on the carbon a few c.c. of the salt. A platinum wire dipping in the salt served to complete the circuit. On heating the carbon to a dull red heat in a Bunsen flame, a violent effervescence takes place, carbon dioxide being evolved; and the voltmeter shows a deflection corresponding to about 1 volt. This deflection remains constant as long as any of the higher oxide is left.

A. Herz has recently shown that the potential gradient in the positive unstratified glow discharge of a vacuum tube decreases as the current increases, and also as the diameter of the tube is increased; but it increases with the pressure, though not as rapidly.

THE BOARDMAN MANUAL TRAINING SCHOOL.

The Boardman Manual Training High School building, situated at the corner of Broadway and York Square, New Haven, Conn., is wholly the gift of Mrs. Lucy H. Boardman, who, in memory of her husband, the late Hon. William W. Boardman, generously donated $70,000 for this purpose. The New Haven City School district furnished land and equipment, and the school was regularly opened last September with 200 pupils.

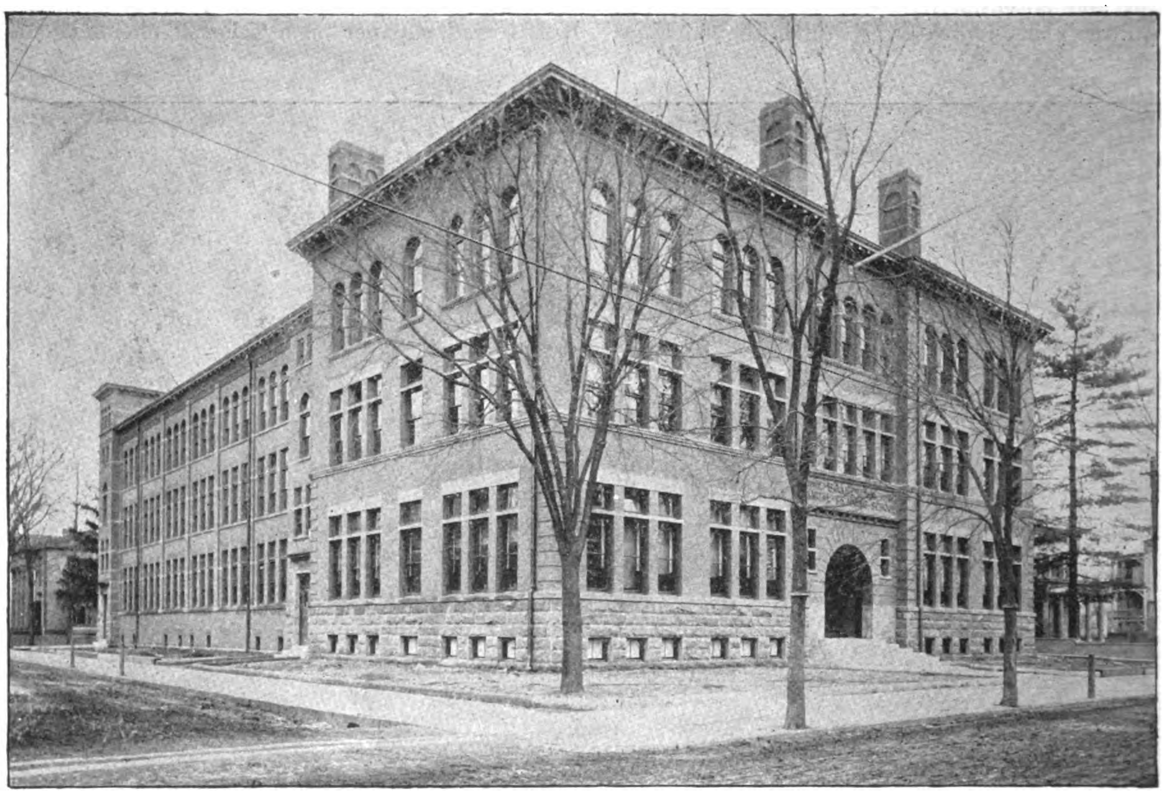
At present no especial attention is given to the preparation of students for entrance to the freshman classes of Yale University. Latin is entirely omitted from the list of studies, and other branches are curtailed or left out to make room for that which seems of more importance in the education of those who can go no further than the High School. On the other hand, many subjects taught in the University form part of the curriculum of the Boardman School. In short, the idea is to make this course, as complete as possible in itself, and to equip its graduates for the business of life with the knowledge which promises to be of most practical use to them. The mind, the hand, and the eye are to be trained for this purpose, and it is not thought advisable to sacrifice the education of the many for the benefit of a few who can afford to give more time and go further. For such, the city of New Haven provides ample opportunity elsewhere.

In the Sheffield Scientific School, however, "for the benefit of those who, being fully qualified, desire to pursue particular studies without reference to obtaining a degree, special or irregular students are received in most of the departments, not however in the select course, nor in the freshman class." In other words, those qualified can enter the Junior class as special students, in either of the three engineering departments, civil, mechanical or electrical; or in the chemical and biological departments, and can take all of the regular studies for the remainder of the course, receiving at graduation a certificate from the professor in charge, but not the degree of Ph. B.

The course of instruction pursued at the Boardman School will be of a character peculiarly fitted to give the knowledge necessary, and it is believed that its graduates will be fully competent to take advantage of the opportunity offered, and that the Sheffield School will be pleased to receive them. The regular work supplemented by some outside study, affords ample preparation for admission to institutions where Latin is not exacted, such as Harvard University, Lawrence Scientific School, Cornell, Massachusetts Institute of Technology, Stevens Institute of Technology, Lehigh University, Smith College Scientific Course, Wellesley College Scientific Course, and the University of Pennsylvania.

Mr. Thos. W. Mather, the Principal of the Boardman School, graduated from the Sheffield Scientific School of Yale in 1871, after completing the course in civil engineering. He then took a post graduate course in mechanical enginering, receiving the degree of D. E. (dynamic engineer) in '73. His first practical work was as assistant engineer, superintending the construction of piers and abutments for an iron bridge over the Quinnipiac River. He then became draughtsman at the Colts Arms Co. of Hartford. Later he opened an office as consulting engineer at New Haven, and until 1882 was actively engaged in engineering work in great variety. Offered the position of instructor in mechanical engineering at the Sheffield School, he took charge of the course in machine design and experimental engineering. Later, passing part of this work into other hands, he gave especial attention to applied mechanics, covering with lectures and recitations nearly all the studies of this class followed in the university. During this period he also found time for much outside work, especially in steam engineering and hydraulics, acting as expert in many important law suits. In May, '94, he severed his connection with the University to take the position he now holds, attracted by a broad and undeveloped field in education and hoping to aid in building up a famous school.

Gen. E. S. Greeley generously offered to equip the school with electrical material and his proposal has been gratefully accepted by the Board of Education. The gift includes the latest improvements in educational electrical apparatus, and the equipment is at once well selected and complete.



THE BOARDMAN MANUAL TRAINING SCHOOL, NEW HAVEN, CONN.

ELECTRICITY IN SHAMOKIN, PA.

The coal company at Shamokin which is about to introduce electricity in its mines, not only for illuminating purposes, but as a motive power replacing mules, has first counted the cost and found economic advantage in the marked innovation, which may therefore be taken to foreshadow cheapened production and consequent gain to the vast network of industries to which the item of fuel is a consideration of importance.

WATER POWER TRANSMISSION IN WASHINGTON STATE.

A power house next in size to the plant at Niagara Falls, is to be built this year in the Stuck Valley, ten miles east of Tacoma. The White River Water Power Company, with a capital of $2,000,000, has been incorporated under the laws of New Jersey. Water from White River below Buckley, will be carried to Lake Tappa, which will be utilized as a storage reservoir. The water is to be diverted to the edge of the bluff overhanging Stuck Valley, giving a fall of 500 feet to the power house, where a generator will be located, capable of developing 25,000 horse-power, without counting the surplus power stored in Lake Tappa, by the use of which 50,000 horse-power can be developed.

NEW STATION OF THE BRUSH ELECTRIC CO., BALTIMORE.

It is now about a year ago that the station of the Brush Electric Co., of Baltimore was almost entirely destroyed by fire. With undaunted energy the officers of the company made temporary arrangements to supply their customers and the city lights with current, and at the same time set to work planning a new station. In this work they have steadily kept in view the latest progress and trend in electrical work and the result is a new station which may well be considered one of the model plants in the country.

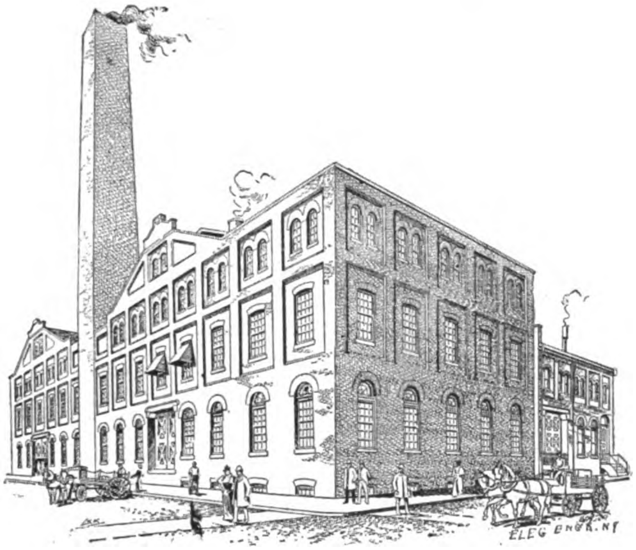


FIG. 1.—THE BRUSH ELECTRIC LIGHT CO.'S NEW STATION, BALTIMORE.

The Station Building.—The new station shown in Fig. 1 consists of a one-story building, with substantial brick walls. The roof is one span without columns, thirty feet to the underside of truss, and sixty-five feet high at its peak. The roof was built with especial regard to strength, and is capable of carrying 20,000 pounds at any one point. It is of iron, and lined with fireproof material to prevent condensation of moisture and the consequent dripping on the apparatus. As the floor is granolithic, the building is absolutely fireproof. The only woodwork about it is to be found in the doors and window frames. Beneath the floor of the station there are a series of brick passages, two of which are arranged to carry the exhaust steam, water and drain pipes, and two others to carry the large cables from the dynamos to the switchboards.

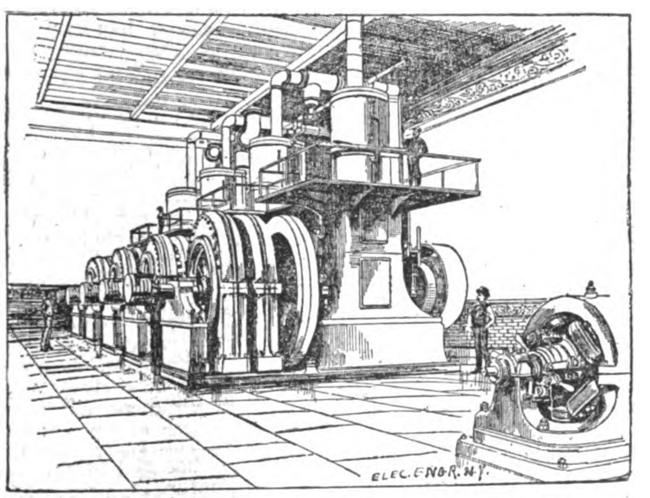


FIG. 2.—WESTINGHOUSE DIRECT CONNECTED 2-PHASE ALTERNATORS.

The Dynamos.—The equipment of the station is of the most modern type. It is arranged for four two-phase Westinghouse alternating machines, each having a capacity of 15,000 sixteen candle-power lights, shown in Fig. 2. These generators are the largest now in use in any plant in the United States. They are direct-coupled to vertical double-acting Westinghouse compound engines, thus dispensing with the loss of power due to the use of belts, and eliminating the chances of breakdowns due to belt breakage, etc. The construction of these equipments is strong and massive. Each engine and dynamo weighs 139 tons, the armatures alone weighing forty-six thousand pounds.

The engines are placed on massive and solid foundations of brick.

It is the intention of the company to run eventually all the arc lights and motors on the two-phase circuits and using the Tesla two-phase motors.

The present direct current arc light equipment of the station consists of eighteen 65-light machines of the Brush type, and five 80-light machines of the Westinghouse type. The machines are belted to vertical Westinghouse compound engines. From this equipment is derived the power which furnishes the light used on the street lamps and on the commercial arc lights.

The Switchboard.—Not the least interesting features in the station are the two switchboards. The one for incandescent service, shown in Fig. 3, is made of Italian marble, and erected on a fireproof frame. It is two stories high, the lower half containing the switches for the handling of the large machines, and the upper half the switches and appliances for the individual circuits of the various parts of the city. The board has a capacity of 120,000 lights. The cables to and from the board are carried underground, in the vaults above alluded to. The cost of this switchboard was about $20,000.

The arc switchboard is constructed of Tennessee and Italian marble on a non-combustible frame, and designed for handling 4,000 standard 2,000 c. p. arc lights. The three Westinghouse two-phase generators are energized by 2 Westinghouse continuous current exciters of 60 H. P. each. In addition to their work as exciters these machines also furnish current which is distributed for power purposes within the station and also for operating elevators, printing presses, planes, hoisting machines aud various other kinds of heavy work in manufacturing establishments throughout the city.

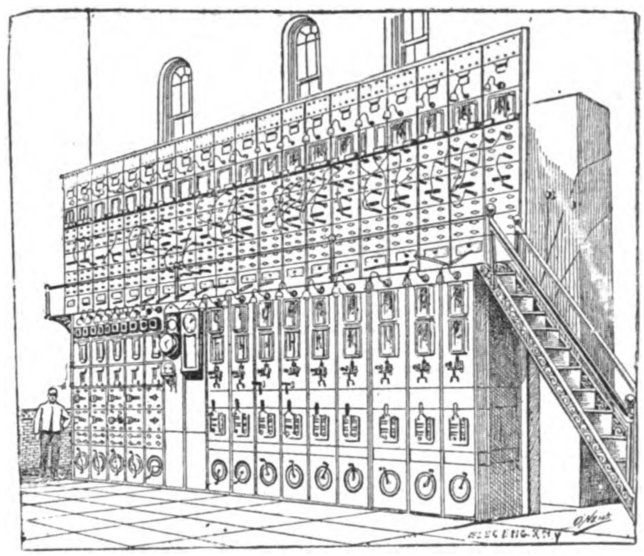
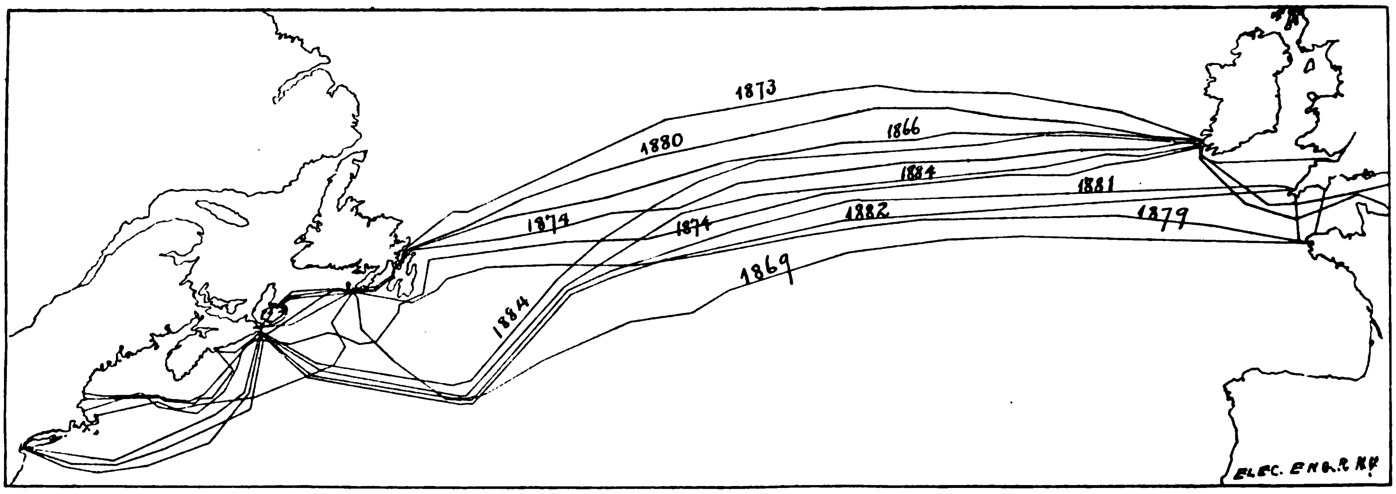


FIG. 3.—THE INCANDESCENT SWITCHBOARD, BRUSH STATION, BALTIMORE.

The Boiler House lies north of the station. It is of brick, and one story in height. In the interior of the building it is forty feet from cement floor to the underside of the iron truss, supporting the roof. One part of the building contains a large tank for the storage of coal, capable of holding 1,500 tons. The house contains five vertical Climax water-tube boilers of 500 nominal horsepower capacity each, with space for three more boilers of this type. In addition to this there are two batteries of horizontal tubular boilers, four in each battery. These are not now in regular use, but are retained for occasions of emergency. The company contemplates replacing them shortly with horizontal water tube boilers.

The boiler-house is throughly equipped with duplex pumps, heaters, etc., in duplicate, and all other necessary appliances. Arrangements are now being completed for the introduction there of coal-handling apparatus and mechanical stokers. The coal is delivered into the boiler-house by car from a siding on Constitution street, direct from the Northern Central Railway. Soft coal mixed with anthracite screenings is used, and from fifty to seventy-five tons a day is consumed. The smoke from the boilers is carried off by two stacks, each 150 feet high. One is of brick,



THE ATLANTIC CABLES, WITH DATES OF LAYING.

and nine feet in diameter, and the other of iron, eight feet in diameter.

The water used at the station for the purpose of generating the electricity is drawn from the city's water supply. One of the big mains that comes from the Lake Roland reservoir is tapped near the station, and the water is run into the building through a private main. The company pays for the water by meter measurement.

The present officers of the Company are: Summerfield Baldwin, president; Dr. Wm. Whitridge, vice-president; H. C. Tudor, secretary and treasurer; George H. Blaxter, general manager; Messrs. Baldwin, Whitridge, Blaxter, Edgar G. Miller, Francis E. Waters, James E. Hooper, Lloyd L. Jackson, George W. Hebard and Ph. Fred Kobbe, directors.

SUBMARINE TELEGRAPH CABLES.[1]—I.

The subject of submarine telegraphy is to me a very dry one, for, having been actively engaged in the work for twenty-one years, you will quite understand that it has become somewhat monotonous. There are many who have lectured and written about it, but very few of them have had much practical experience; I therefore purpose giving you a few details from a sailor's point of view.

There are many text-books published which give a superabundance of technical phraseology and mathematical formulas of "how to do it," but, after a long experience at the work, I have come to the conclusion that the essential requirement is a capacity to understand the nature of the work, and to practically reason out the details of the many difficulties which are continually presenting themselves; and that the men best qualified for this important work are those who Sir Wm. Thomson (now Lord Kelvin) once figuratively pictured as *living on the edge of a precipice*, their life's training having taught them to be always on the alert and ever ready to act with deliberation at a moment's notice, in any emergency.

Need I say that he was speaking of sailors?

It is also stated that the late Sir James Anderson once said that "it requires only an educated boatswain to lay telegraph cables." I am quite aware that the so-called cable engineers argue differently; but surely experience must have taught them otherwise, and that it requires something more than knowledge of "catenary curves" to guard against the many contingencies which may arise in cable-laying.

Submarine telegraph cables, as I suppose most present are aware, consist of a copper conductor, covered with an insulating substance (the best material known for submarine purposes is gutta percha); this is all that is required for the exchange of signals, it may be through thousands of miles; but, in order to protect it from injury, it must also be armored, to guard it against the thousand and one dangers to which it may be exposed. This armor, or sheathing, as it is technically termed, consists of iron or steel wires and sundry coverings of hemp laid up helically, each layer being well coated with a bituminous compound; the cable as now completed is coiled into large iron tanks and kept under water, where it remains ready for shipment.

The size and weight of cables vary according to the conditions and locality for which they are destined, so that, while some shore ends weigh as much as 20 tons per mile, the modern type of deep-sea cable weighs only about 2 tons per mile. The earlier deep-water cables were much lighter.

During the whole process of manufacture the strictest supervision is exercised and a continuous watch kept on the electrical tests, so as to guard against or detect the slightest fault, should any occur in the insulation.

After the completion of the cable, it is transferred from the factory to the ship, coiled into her tanks and again immersed in water, in order to keep a perfect check on its electrical condition. The ship then proceeds to the place where the shore end is to be landed; this is done either by raft, a number of boats, or floated on buoys through the surf to the beach. The end being landed, it is taken into the cable house, the usual test applied, and if in sound electrical condition the ship proceeds, laying the cable on a route which had been previously plotted on her charts.

The paying-out machinery consists of sundry small guiding wheels and a large drum around which the cable runs (usually six feet in diameter), with brake pulleys attached, fitted in such a manner that weights can be easily adjusted and the speed of the cable running out kept under control. A dynamometer also stands between the paying-out drum and stern of the ship to show the strain on the cable as it passes into the sea. The speed of its running out should be a certain percentage greater than the speed of the ship, so that it may conform to any undulations in the bed of the ocean, on which it is intended to rest. Some skill and a great deal of attention is required, in order that too much slack, on the one hand, and on the other, the greater danger of laying it too tight, and thereby suspending it from peak to peak of submarine mountains, may be prevented, and which generally are only discovered after the cables are broken and repairing operations commenced. This is one of the results of laying cables by mathematical formulae rather than by practical common sense. Another danger at the present time is the excessive speed practiced by some in cable laying and the small amount of slack inserted.

I have here a Christmas and New Year card; on the back of it is a report of the laying of a new Atlantic cable, in which is the statement in bold type, "THE RECORD IN CABLE LAYING BROKEN." This report goes to show that the ship had laid the deep-water portion of it at a speed of rather over eight knots. I fail to see why this fact should be advertised far and wide, when it is well known that a high rate of speed in cable laying, in unknown depths, is likely to prove disastrous to the life of any cable. Then, why all this furor? Are cable engineers again losing their heads, as some did in the bygone days, when it was said of them that, "the cable ship could always be found by following the trail of the soda water and brandy bottles, and that their servants were clothed in silk stockings, breeches and and powdered wigs." The records of laying the early Atlantic cables show that the maximum speed was six knots, and that a percentage of from eleven to thirteen was allowed for slack; notwithstanding this precaution, the repair of certain fractures in them has proved beyond doubt that they were broken through having been suspended over inequalities at the bottom. Last year, on two occasions, we repaired a cable which had been broken from this cause, although only five years old and laid in a moderate depth of water. Scientific evidence has at least once been brought in to prove that a convulsion of nature broke certain cables in deep water; but, as I repaired those cables, I am quite certain that there was no ground whatever for such an assumption.

Having given you an idea what telegraph cables are, and some of the dangers which beset them in their infancy, also, that considerable care and watchfulness is required when depositing them in the ocean, in order that they may rest continuously on

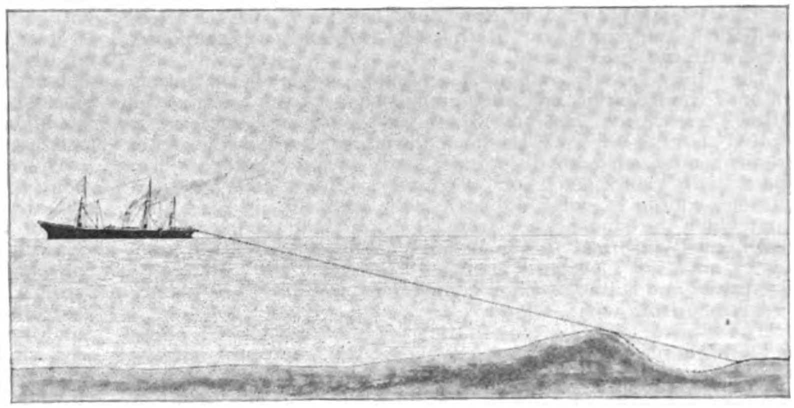
1. Lecture delivered before the Kearsarge Association of Naval Veterans of Boston, February 14, 1895, by Samuel Trott, Member of the Institution of Electrical Engineers, and Fellow of the Meteorological Society, etc., of England, Commander of the Anglo-American Telegraph Company's Steamship "Minia."

the bottom, I will now pass on to the more important part of my paper, namely, the "Recovery and Repair of Broken Cables." This requires great skill and exactitude, and a perfect knowledge of all the difficulties likely to be met with and which have always more or less to be encountered, so that in making a comparison between the two classes of work, cable *laying* sinks into utter insignificance.

I had now better explain to you the reason why telegraph cables require repairing so often, that ships are constantly kept in commission for that purpose, at a large expense to the companies owning them. I will also a little later give you some idea of the enormous amount of money which has been spent in attempts to recover cables in deep water.

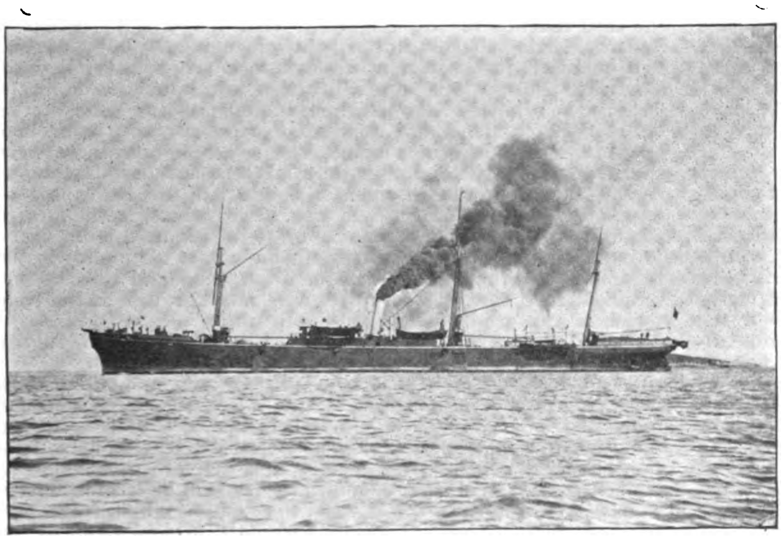
There are many causes of interruptions and faults in cables in the North Atlantic, some of which are abrasion on rocks and crushing by ice where lying in shallow water, or when landed in exposed places; occasionally, also, there are faults made in the insulator by the ravages of marine borers; but the greatest number of breaks we have to contend with are caused by the fishing schooners dragging their anchors in gales of wind; generally, they know when they hook a cable, and some of them will then cut away their hawsers, to avoid further damage, knowing that they will be compensated for their loss by the cable companies, while others do their utmost to heave them to the surface, and in some few cases have then hacked them through with an axe. An important three conductor cable was cut by the captain and crew of the three-masted fishing schooner "Henry S. Woodruff," of Lamoine, Maine. Such a flagrant piece of vandalism, I am glad to say, does not often occur, and to the credit of the vast number of sturdy fishermen who man the large fishing fleets belonging to this State of Massachusetts, I am glad to bear testimony, that there is no such case on record against them. The law is very severe in such cases. It is a State Prison offense; a heavy fine also can be inflicted, and that would be no bar to a suit for damages. However, that "Down East" Captain escaped the penalties, he having been washed overboard and drowned shortly afterwards. I have already alluded to breaks occurring through laying cables too tight, or at too great a speed. These become more frequent as age advances, or oxidation eats away the iron or steel wires and thereby weakens them, so that they can no longer sustain their own weight in the suspended parts. Lastly, there is the natural decay and corrosion which takes place in all depths of water; and as the nature of the bottom is continually changing, so also is this corrosion and decay ever varying, and while in places on good bottom they are sometimes found, after twenty or more years' immersion, practically equal to new, yet, there are other places where bottom is bad, or where they may have been suspended, that the iron or steel wires are completely eaten away, only a few years after having been laid.

Another great danger to cables has arisen of late years. I allude to the practice of laying them across the Atlantic between those already laid, and which had previously been considered only a safe distance from each other, thirty miles being taken as the minimum in deep water. When it is taken into account that the different ships employed laying cables may have run for several consecutive days without obtaining a single observation, we may be sure that there is a great chance of some of them being overlaid, or so dangerously near to each other, that there will be a great risk of breaking a wrong cable, when repairing operations commence, and which must assuredly come in the near future. Besides lying parallel to each other, there are also many places where they cross. Four repairs have already been made at these crossings; another also is now in progress, with a loss to the companies interested of hundreds of miles of cable, which had to be abandoned, in order to avoid the risk of breaking the others.



A

PROFILE OF BOTTOM OF THE ATLANTIC AS SURVEYED BY CABLE SHIP "MINIA." CABLE WAS FOUND BROKEN AT A.



ANGLO-AMERICAN CABLE STEAMSHIP "MINIA."

Is it a strange coincidence that some cables have already been broken soon after repairing operations commenced?

When it is taken into account, also, that this type of cable may be roughly estimated at $1,000 per mile, is it not wonderful that the companies who are continually suffering such losses do not take steps to recover compensation, and prevent this baneful practice in future?

By referring to charts showing the positions of the telegraph cables as given by the companies who laid them, one will not be surprised at what has been stated, and that there is a day of reckoning coming. (See chart on page 366.)

UTILIZING THE EARTH'S CENTRAL HEAT.

One of the most interesting proposals for the Paris Exposition of 1905 is that made by M. Paschal Grousset, a Radical Deputy. M. Grousset proposes to bore a mine 1,500 metres (4,850 feet) in depth in the middle of the exposition grounds. Such a mine would, he argues, settle forever the disputed question as to whether or not the interior of the earth is a mass of fire, for at a depth of nearly 5,000 feet the temperature would sensibly increase, if the contention of many geologists be correct. The experience of miners shows that below a certain depth the temperature rises 1 degree Centigrade per 33 metres. If this law continues to hold good at greater depths, a temperature of 100 degrees Centigrade above the ordinary temperature of the locality would be found at a depth of three kilometres, and at 20 kilometres a temperature of 666 degrees —a temperature at which most substances melt. M. Grousset is astonished that men should never have sought to verify a question of such importance, and suggests that the occasion of a great exhibition would be well adapted to the experiment, since the curiosity of the public might be made to cover the cost of the undertaking.

He suggests further that horizontal galleries should be excavated at various depths and united by vertical shafts served by elevators. There would be electric light and perfect ventilation.

The cost of the whole undertaking M. Grousset estimates at 12,000,000 or at the outside, 15,000,000 francs ($3,000,000). The questions he hopes to elucidate by it are: (a) Whether the theory of the central fire of the earth be fact or fiction; (b) whether this source of internal heat, if such exist, be accessible and utilizable; (c) whether or not the sub-soil of Paris serves as roof to a vast ocean of soft water. These are all interesting points.

YOUNGSTOWN, O.—Capitalists subscribed $50,000 in two hours to build, equip and operate a telephone exchange under the patents of the Harrison Telephone company. It will furnish service at less than half the present rate.

THE HOLLY GRAVITY RETURN SYSTEM FOR UTILIZING WATER OF CONDENSATION.

One of the most recent valuable adjuncts to steam economy is the system of returning condensation water from engines and piping of steam plants devised by Mr. E. P. Holly, of the Holly Steam Engineering Co., of 344 Butler Exchange, Providence, R. I. The system has been installed in connection with a number of large steam plants, among others, quite recently, in the power house of the Broadway cable road in New York City; and further below we describe the equipment of the new Baltimore tunnel power house with the same system.

The Holly gravity return is a device employed to return water of condensation and entrainment back to the boiler at the initial pressure, or less, and where the boiler or generator is located above or below the points or elevations at which the steam used is condensed, without pumps, traps or any similar device, and actually return the water by gravity. This is done by maintaining a column of water higher than the water line in the boiler, from which the condensation from all steam-using devices will be continuously returned to the boiler. This is carried out in practice by means of a properly arranged "Receiver" and "Standpipe Separator" and suitable boiler connections which will be readily understood from what follows.

The receiver, Fig. 1 is a cylindrical pipe provided with heads and a discharge neck shown at the right. The water of condensation enters through the suction-T at the left hand establishing a low water line, the position of which depends on the amount of work to be done in the receiver.

The head at the right is provided in the centre with a series of holes vertically arranged, their combined area being equal to that of the pipe G, which is the riser to the standpipe separator, Fig. 4. The separator H is made either of four or six inch pipe, and is usually about two feet in length, and provided with caps at top and bottom. The riser G from the receiver enters the side, ending in an open T as shown. From the top a small pipe I leads to a controlling valve I' which is a small size of the reducing valve, Fig. 2, to be described presently. At the bottom is the return pipe H^1 leading to the boiler or boilers, if there are more than one. H^3 is a valve opening from H^1 into the sewer pipe. Between H^1 and the boiler there is a gate valve and check valve in the order named.

The standpipe separator is placed well above the water line of the boiler, the required distance varying under different conditions. It will be seen that if steam at practically boiler pressure is admitted to the separator and a means provided for raising the water of condensation from a receiver, a column of water will be formed which will rise to such a height above the water line in the boiler that its weight will be sufficient to open the check valve and the water will flow into the boiler. Returning now to the receiver, the operation of the device is as follows: All condensation is brought to the upper inlet of the suction-T, which must be at a point below all pipes or separators to be drained. Steam, at as near boiler pressure as possible, is brought to the lower inlet. This steam acts as in an injector, to draw the water into the receiver, and also to maintain boiler pressure in the same. In starting the device, the valve between return pipe H^1 and boiler is closed and valve H^3 opened. Steam at once flows from the receiver up the riser G to the separator and through the valve H^3 to the sewer, *carrying the water of condensation with it* in finely divided particles. This result is brought about by the peculiar arrangement of the holes in the head of the receiver. As soon as a steady flow of steam and water from receiver to stand pipe is obtained, the valve H^3 is closed and the valve between H^1 and boiler opened. Steam will continue to flow from the stand pipe through the small pipe I and reducing valve I^1, while the water which is brought up with the steam will fall to the bottom of the stand pipe, forming a column which will soon reach a sufficient height above the water line in the boiler to overcome the resistance of check valve, plus the difference in pressure between stand pipe and boiler; and a return flow of water to the boiler is established which is continuous, requiring no further attention. This "working water line" in the stand pipe is somewhere in the vertical pipe H^1 and does not rise to the enlarged portion H which is simply a separator to divide the particles of water from the steam as it is delivered from the receiver. The amount of steam flowing from the stand pipe is regulated by the reducing valve I^1 to a quantity just sufficient to raise the amount of condensation in each special case. This quantity of steam is so small as compared with the amount of water returned that the loss may be disregarded. If it is desired, however, this loss may be obviated by connecting the discharge from valve I^1 with a heater or radiator. The distance of the receiver below the boiler, or the linear distance of receiver and standpipe separator from boiler, within limits which would be likely to occur in practice, does not interfere with the satisfactory working of the system in any way whatever.

One of the most interesting details of this system is the reducing valve referred to above and shown in section in Fig. 2, and known as the "Holly Simplicity Reducing Valve." It consists of two chambers, A and B, screwed together as shown. A valve disc C is held in position by a guide and piston F. Water collects in the space under F, and the piston with its surrounding cylinder acts as a dashpot to prevent any sudden movement or chattering of the disc. The disc is free to move vertically; the downward movement being limited by its face coming in contact with the valve seat, or by the bottom of piston F touching the stem H, which can be either raised or lowered. The action of the valve is as follows. Steam enters the chamber A at some initial pressure; the disc is raised from its seat slightly, by means of the regulating stem H, and steam then flows from A to the upper chamber B through orifice D and the narrow space between the disc and its seat. Suppose, for example the valve is placed between a boiler carrying high pressure and a series of heating coils in which a pressure of $\frac{1}{10}$ that of the boiler is desired.

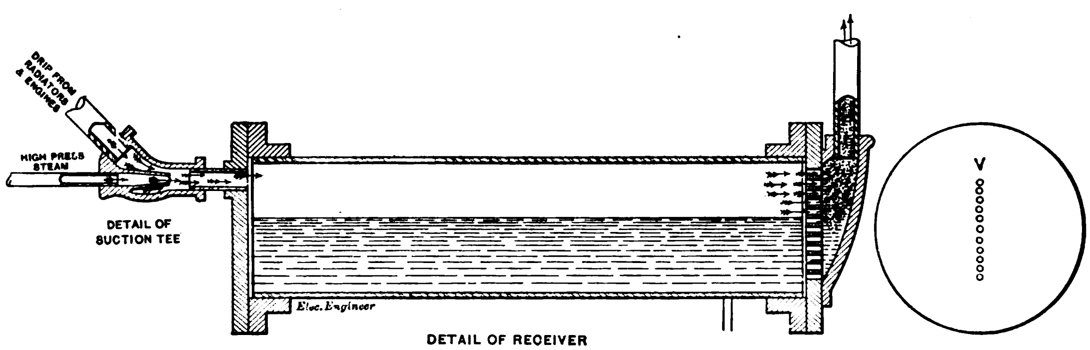


FIG. 1.—SUCTION TEE AND RECEIVER, HOLLY GRAVITY RETURN SYSTEM.

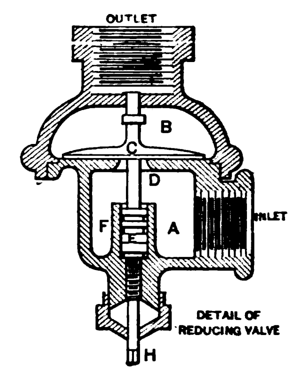


FIG. 2.—HOLLY REDUCING VALVE.

The flow of steam is allowed to continue until the pressure in the coils reaches the desired point, when the stem H is carefully lowered, letting the disc fall and thus reducing the flow of steam to a quantity just sufficient to maintain the pressure desired. The valve is now "set" and all further regulation is automatic. The disc is balanced between the terminal pressure acting on its entire upper surface, and the initial pressure acting on an area equal to that of the orifice D plus, *some reduced pressure*, between the disc and its seat, acting on its lower surface. If for any reason the pressure in chamber B should fall, the disc would no longer be balanced and would rise, thus increasing the flow of steam, and bringing the pressure up to the required point again. If on the other hand the pressure in B becomes too high, the disc is forced down, the flow of steam diminished and the pressure reduced; and thus a constant ratio between the initial and terminal pressure is maintained at all times.

After the valve is once "set" for a certain ratio of reduction under the given conditions, it requires no further regulation.

Fig. 3 shows an elevation of the Holly Gravity Return System as it is being placed in the new Tunnel Power House of the Baltimore & Ohio Railroad Co., in Baltimore. It is erected in combination with the duplex system of steam delivery which is to be used, and will continuously receive and deliver to the boilers all condensation and entrainment in the system between the large overhead separators at the left and the extreme ends of the high pressure mains A and A^1 which terminate in separators at the right, a distance of about 200 ft.

From the under side of the elbows on the vertical risers of steam mains A and A^1, a $1\frac{1}{4}''$ pipe is carried to the 8" return main in the engine room, to which it is connected by a suction-T. This serves the double purpose of returning the condensation from the steam mains and furnishing steam at boiler pressure to the receiver. The receiver C is located, as shown, in a pit, walled with brick laid in cement; its demensions are six feet long by fourteen inches in diameter.

Included in this system are eight separators and two large expansion joints to be drained.

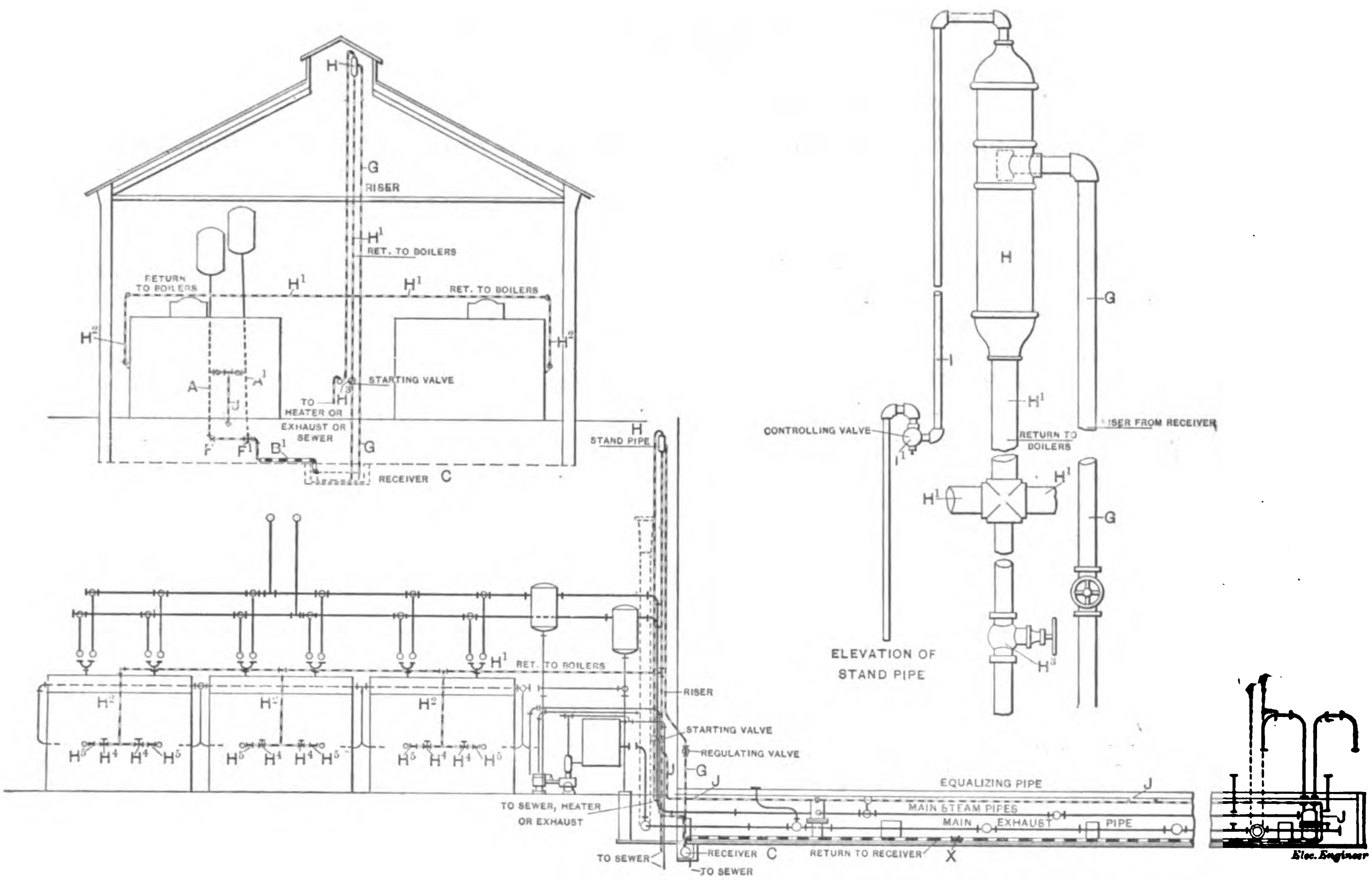
Beginning at the right, two lines of 3" pipe are carried for a distance of about ninety feet toward the receiver; to these return mains, four of the separators are joined by 1½" pipe provided with suction T's. The object of the suction T in this connection is to insure a position flow from the separator to return main, even though the pressure in the separator be slightly less than that in the main.

For the remainder of the distance to the receiver the return is carried through a single line of pipe; the diameter being 2½" to the point x and 3" from there to the receiver. This return pipe is much larger that would be required to convey the water of condensation alone, but is is given this extra size to better utilize the slight grade obtainable and to insure a more perfect equalization of pressure throughout the entire system.

The remaining separators are joined to the return main by 1½" copper pipe, making long sweep bends to allow for expansion. Starting from the steam mains in the boiler room, a 2½" equalizing pipe J is run to the extreme end of the return main at the right, furnishing the latter with steam at practically boiler pressure.

The discharge pipe or riser G from the receiver is connected to the discharge neck at the end opposite the return pipe B¹; and rises above the engine room floor; then diagonally upward through the partition wall into the boiler room. It then ascends vertically to a point about twenty-five feet above the water line in the boilers, where it terminates in an open T, inside the short 6" stand pipe separator H. At the top of the stand pipe separator is a ½" pipe I extending down to a point about five feet above the boiler room floor, and there provided with a ½" Holly controlling valve for regulating the flow of steam from stand pipe, as previously described. As an indication of how little steam is necessary for this controlling feature it is only necessary to state that, if condensed, it would amount to about 600 lbs. of water in twenty-four hours, as a maximum.

Assuming the evaporation of the boilers to be eight pounds of water per pound of coal, we have seventy-five pounds of coal at, say, $3 per ton, which equals twelve cents,—the cost of returning more than twenty tons of water to the boilers. While the quantity is not great, it must be positive, continuous, and contain all the air entering the receiver. All pipes in the system including the stand pipe separator and receiver are to be covered with magnesia sectional covering and moulded fittings.



FIGS. 3 AND 4.—ELEVATION OF HOLLY GRAVITY SYSTEM, IN BALTIMORE TUNNEL POWER HOUSE, AND DETAIL OF STAND PIPE.

ELECTRICAL POWER TRANSMISSION IN EGYPT.

The cotton growers in the United States will find themselves confronted with another competitor if the proposal just submitted by a French engineer for creating new cotton fields in Egypt is adopted. At the present moment the staple productions of the land of the Pharaohs consist of cereal crops, of which the value has been declining to such an extent within recent years that the revenue to the growers is from 30 to 40 per cent. less than what it was in 1882. In face of this ruinous contraction the French engineer, M. Prompt, proposes a scheme for a more efficient system of irrigation and for supplying an abundance of cheap motive power whereby it will be possible to substitute cotton and sugar cane for the cereals and establish factories for the treatment of the produce. To attain this end he proposes to utilize the cataracts of the Nile in the same way as the Niagara Falls for the distribution of power by electricity.

An artificial fall of 15 metres would be created on the Nile, near Assouan, and this would hold in reserve 500,000,000 cubic metres of water for irrigation at the same time that the cataract would provide 40,000 horse power. The power could be supplied at the exceedingly low figure of 2 centimes per horse power hour, and would be sufficient for operating 130 cotton factories, giving employment to 40,000 hands and consuming about 100,000 tons of cotton, or about one-half the entire production of the country.

By this means an important home industry would be created, and the price of cotton would advance to a more remunerative level. The water kept in reserve would allow of the irrigation of 280,000 hectares of land which could produce about 450,000 tons of sugar. These results could be still further increased by the making of another fall of 5 meters near Cairo, where there is a vast area of land favorable to cultivation of cotton and sugar cane.

It is estimated that these works can be carried out within a period of three years, and that their total cost will be eight million dollars, upon which the net revenue is expected to be ten per cent. The proposal of M. Prompt is meeting with a great deal of favor in Egypt, and if found to be practicable it is hardly likely that any difficulty will be met with in finding the necessary capital to carry out the undertaking.

In any event, the project is interesting enough as showing that there is an increasing tendency everywhere to utilize electricity for industrial purposes wherever it can be done with advantage.

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THE OLDEST ELECTRICAL JOURNAL IN AMERICA.

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CONTENTS.

MR. A. C. SHAW.

IN keeping with the announcement made last week, THE ELECTRICAL ENGINEER is now glad to inform its readers and friends that Mr. A. C. Shaw, so long its New England representative, has assumed the business management with this issue, and that New York city will hereafter be his headquarters. It is needless to ask for Mr. Shaw the courtesy and consideration always extended readily to his predecessors, Messrs. Colvin and Phelps; on the contrary, it is felt that the reputation he so deservedly enjoys all through New England will follow him in his new duties, and that his persistent, conscientious good work will be, as ever, one of the largest elements in winning esteem for the management. Mr. Shaw will not, however, be lost to New England, as he intends to keep a close personal supervision over the business of the ENGINEER in that important part of the country.

THE SUCCESS OF THE ELECTRIC ELEVATOR.

WE are all so accustomed to look upon electric transportation as conveyance merely in a horizontal direction from place to place, that we are apt to lose sight of another very important kind of transportation, which is increasing in a ratio as great as, if not greater than, that of the horizontal, such as electric railway transportation. We refer to the rapid increase of passenger elevator work, which has reached imposing dimensions. There are in the United States at the present time possibly not less than 50,000 elevators in operation, there being in New York City alone close on to 6,000. If we consider for a moment that there are less than 3,000 street cars employed in New York City, one can gain some idea of the amount of vertical transportation accomplished. If an accurate estimate could be established, it would probably show that more persons are transferred vertically than horizontally in New York City during the day. Up to within a very recent period the the hydraulic elevator has been looked upon as the elevator par excellence, but recent improvements in electric elevator work have, without question, brought the electric elevator abreast of the hydraulic. This is true not only as to the cost of operation and maintenance, but as to the space occupied, and other incidental advantages, not the least among which is, that the electric elevator can be connected directly to the street main and made independent of any local "isolated" supply of power or current. It is this fact which, indeed, has brought about the installation of numerous electric elevators in buildings and dwellings, which could not have obtained these facilities by any other means. As a source of income for central stations, there appears to us to be no more promising field than that of elevator work in private dwellings, and our belief is based on the results of actual practice. We have before us a list of some 15 typical cases of this class of work among the many installations of this nature operated by the Edison Electric Illuminating Company, of New York. This Company, which runs some 250 electric elevators of a total of 3,000 H. P., recognizing the fluctuating nature of the load in these installations, makes a minimum charge for each elevator connected, which consumers are perfectly willing to pay; and in order to show the manner in which the

arrangement works, we select below a few of the cases above referred to:

	Type of Motor.	Date of Bill.	Amount of Bill Rendered with Minimum Charge.	Actual Current Consumption Excluding Minimum Charge.
No. 1 Residence.	5 H. P.	Dec.	$ 1.44	$ 1.44
		Jan.	3.75	3.75
		Feb.	3.88	3.88
No. 2 Residence.	5 H. P.	Nov.	3.00	
		Dec.	3.00	
		Jan.	3.00	
		Feb.	3.00	1.63
		Mar.	3.00	
No. 3 Ladies' School........	5 H. P.	Oct.	3.00	
		Nov.	15.20	15.20
		Dec.	14.80	14.80
		Jan.	9.25	9.25
		Feb.	10.06	10.06
		Mar.	11.51	11.51
No. 4 Residence.	5 H. P.	Sept.	28.40	28.40
		Oct.	29.45	29.45
		Nov.	24.90	24.90
		Dec.	29.44	29.44
		Jan.	27.66	27.66
		Feb.	17.82	17.82
No. 5 Residence.	15 H. P.	Sept.	9.19	9.19
		Oct.	15.15	15.15
		Nov.	21.90	21.90
		Dec.	21.60	21.60
		Jan.	16.60	16.60
		Feb.	15.00	15.00
No. 6 Church...	8 H. P.	Jan.	2.87	2.87
		Feb.	3.69	3.69

We note that in but few cases is the charge for actual current consumption smaller than the minimum charge of $3 per month, indicating that tenants use the elevator frequently and are willing to meet the expense for current. In the paper recently read by Mr. H. Ward Leonard, before the American Institute of Electrical Engineers, that gentleman, referring to the peculiarly intermittent nature of the load, advocated a very high charge for electric elevator service on the part of central stations, but experience has abundantly proved to the Company that the compensations brought about in a large system of distribution have made groundless the fears on this score, so that nothing ought to stand in the way of selling current for electric elevators on very nearly the same basis as for any other purpose.

SUMMER ELECTRIC LAUNCHES.

Now that Spring is here, a good deal of activity is being shown in electric launch work, and we are glad to note that several street railway companies are getting ready to put on boats this summer. A curious evidence of the well established position that this comparatively new mode of travel already enjoys is seen in the bill lately introduced in the New York Legislature requiring anybody at all who operates an electric launch—or, for that matter, a naphtha launch—to take out a license as an engineer. For such boats as carry passengers for hire, in deep water, we can see the desirability of some technical knowledge; but it seems to us that for boats inland and on shallow waters it is as unreasonable to ask that their crew shall be expert electricians as it would be to expect the foot-drivers of swan boats to be versed in seamanship. Handling an electric launch is the easiest, simplest thing possible, as the successful fleet of fifty at the World's Fair showed. Moreover, many of the boats are in private hands, used solely by their owners, who are certainly competent to throw a switch right and left. It may be hoped that this absurd piece of legislation will fail to pass.

THE TROLLEY vs. STEAM SITUATION.

The way of the trolley is proving a little hard just now in Connecticut, what with adverse decisions in the courts and setbacks in the Legislature. Judge Hall, of the Superior Court of the State, has just held, apparently, that if the steam companies already supply good service, no parallel trolley can be built. But this seems a rather poor begging of the question. If the steam service were as good, the trolley would not be a dangerous and increasing competitor. As of Connecticut, so is this true of other States. Many instances have already been quoted in these columns, while others crop up all the time. It is not generally known for example that whereas the New York Central formerly ran 5-coach trains between Rochester and Charlotte they now appear to be running none. On the Union Pacific, which once did all the passenger business between Council Bluffs and Omaha, the management has had to take off its trains. The electric road from Colorado Springs to Manitou has taken away half the business of the Denver & Rio Grande between those two points, and has compelled it to reduce its fares into the bargain. Such instances belie Judge Hall's view and will not long be choked down by any legislative interference that is intended to kill rather than regulate.

UNDERWRITERS' RULES.

In our issue of April 6, we published the resolution adopted by the New York Board of Fire Underwriters permitting of the use of the Attix "tube and wire," * * * "under the same conditions where tubing would be permitted." It is this rule which formed the text for Prof. Anthony's brief but pointed paper before the American Institute of Electrical Engineers last week. The claim that an insulated wire, however high in quality, is converted into a "tube and wire," by the addition of a few extra layers of braiding, seems too absurd to require serious discussion but the issue raised by the New York Board in the promulgation of this rule must be met and combated in no uncertain manner. We will not here enter into the motives which may have dictated its adoption, but the rule, if permitted to stand, would allow of a most pernicious reversion to practices long since abandoned as dangerous. It is safe to say that the N. Y. Board's Rule will not be followed by any other insurance body in the country, and its adoption here indicates unmistakably that the N. Y. Board's electrical committee must be thoroughly reorganized if its usefulness is to continue. Even now its inspections are not accepted by many important companies doing business in the Metropolitan District, who have organized a bureau of their own; so that for its own self preservation some radical reform measures would seem desirable.

The General Electric-Westinghouse alliance is reported to be in the *statu quo ante* condition, but no outsider knows just what the "ante" was or why the game flags.

Telephonic agitation in this State has received its quietus in the Legislature. There will be no rate law in 1895. Surely with so much new and brisk competition, rates might be left to settle themselves by the laws of supply and demand.

RESONANCE IN ALTERNATING CURRENT LINES.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.[1]

In a paper, by one of the authors, on the subject of "Impedance," read before the Institute[2] on April 18th, 1893, the drop of pressure in conductors carrying alternating currents and assumed to possess no capacity, was considered. In the present paper, the authors consider the conditions of current and pressure in an alternating current circuit, possessing electrostatic capacity as well as inductance, resistance and leakage.

The authors present formula expressing the variation of electric current and pressure in an alternating current circuit under the most general conditions, and in its simplest form. They give calculations for the pressure and current in any alternating current circuit, by a graphical method, presenting a chart which gives by inspection the polar coördinates of a vector point, representing the hyperbolic cosine or sine of a giver vector whose rectangular coördinates are known. They also investigate the effects of static capacity and of capacity and inductance on the delivery of energy at the distant end of an alternating current circuit.

The conclusions arrived at by the authors are as follows:

(1) The combined effect of capacity and inductance is to produce a tendency to resonance.

(2) The tendency to resonance is favored by high frequency, high insulation, high inductance, high capacity, and high conductance.

(3) When the line is free at the distant end, the resonant effects are more pronounced at that end than at the generator.

(4) The determining factor for the production of resonance is the angle of the vector geometric mean conductor impedance dielectric admittance, and rapidly increases with the same.

(5) The complete wave-length in a resonant line is 2π times the length, in which the reactances of the inductance and the capacity are equal, the maximum difference of pressure or current strength being exhibited in one-quarter of this wave-length.

(6) When resonance occurs, the current and pressure in the circuit are not in phase except at their maximum and minimum values, *i. e.*, at the crests and troughs of the waves.

(7) In resonant circuits, the lag of the pressure and current is 90° between any successive pair of maximum and minimum values.

(8) In ordinary lines, worked sinusoidally at ordinary frequencies, resonant effects are practically negligible.

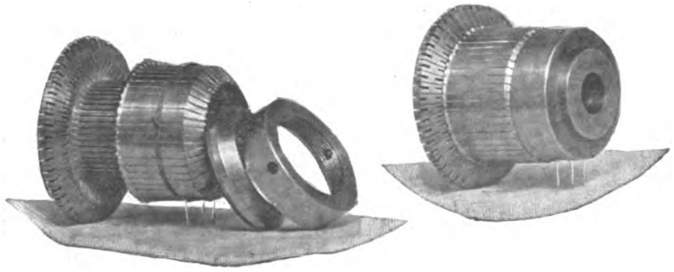
(9) Prominent upper harmonics in the E. M. F. of the generator may sometimes give rise to appreciable resonant effects, although the resonance to the fundamental frequency may be inappreciable.

(10) A certain amount of capacity tends to increase the plant efficiency of the generator, and is, therefore, economical, but marked resonance in a line not only ceases to be economical, but is actually wasteful.

(11) Although, on a large scale, less energy can be delivered at the distant end of a powerfully resonant line, than on a non-resonant line, yet a greater current strength can in some cases be delivered over a powerfully resonant line.

THE PAINTER-MORRISON DETACHABLE SEGMENT COMMUTATOR.

Any method or device which will relieve the dynamo tender and station superintendent of trouble and worry is worthy of attention and as there is no more fruitful source of anxiety than the commutator, our readers will be interested in the Painter-Morrison detachable segment commutator. This commutator

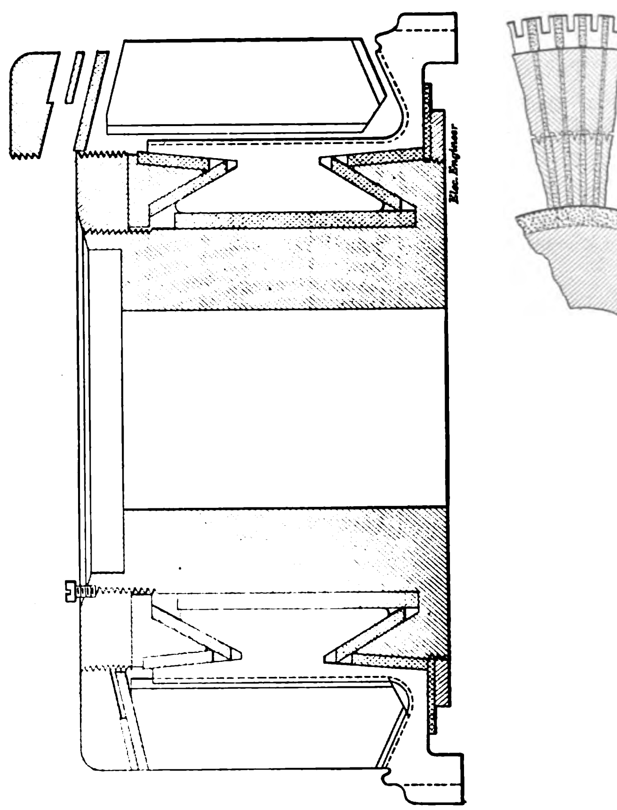


FIGS. 3 AND 4.—PAINTER-MORRISON COMMUTATOR.

is an entirely new departure from the present form, inasmuch as all the wires on armatures now in use have to be disconnected either by unsoldering or unscrewing from those segments when renewals are necessary. This in a great many cases is a very tedious and troublesome job, and more or less injurious to the wires; it also takes considerable time, thereby throwing out of service the armature for that length of time, even if there is a spare one ready to be put on.

The P. & M. commutator is so devised as to not only overcome this difficulty, but also to reduce the cost of the new segments to the mere wear, using up all its material except about one-tenth of the metal in segments.

Our engraving, Fig. 1, shows the commutator in vertical section and Fig. 2 in transverse section showing the method of



FIGS. 1 AND 2.—THE PAINTER-MORRISON COMMUTATOR.

construction; while Fig. 3 shows the manner of building up, and Fig. 4 the complete commutator.

As will be seen, the hub is built and held in the same way as the present form, the only difference being that the wearing part is cut out to an even surface. This then has grooves or slots cut in the end of each segment, the end being formed in a "V"-shape. To renew the commutator it is not necessary to remove the hub from the shaft or disconnect any of the wires.

The segments are made all of one size, and they may be built up in the form of a ring and held together either by rubber bands or rope, and all slid on the hub at one time, as shown in Fig. 3, or they may be set up separately on the hub. The clamping ring is then screwed up on the hub, thereby holding all of the segments at one time, it being understood that the segments have a "V"-shaped end, and on the end and bottom there is a knife edge, which fits into its corresponding groove on the hub. It will be seen that in this way the segments are held firmly, even if there were no mica or insulation between them, and none would be needed if it were not that the face of the commutator is smooth, and fine particles of dust must be kept out.

Thus, the insulation is made about $\frac{1}{1000}$ of an inch smaller than the space between the segments, and this allows the segment to press tightly on the bottom and end of its mate on the hub, thereby making a very firm connection with it. The segments all being of one size, it is unnecessary to turn off the face of the commutator when it is finished.

In case one section is injured in any possible way, the defective one may be lifted out and another one inserted without disturbing the remainder, and this can be done in a few minutes. This arrangement also makes it possible to have a very much thicker insulation between the sections on the hub, and also between the rim where the wires are connected, thus reducing the chance of poor insulation. The shoes or segments then have the same thickness of insulation as is now used.

In practice, the renewable segments will have the mica insulation already fastened to one side, and for an ordinary car motor, the commutator can be built up in about 30 minutes. This commutator is being introduced by the Morrison Southern Electric Co. of Baltimore, Md.

1. Abstract of a paper read before the American Institute of Electrical Engineers.
2. Transactions. A. I. E. E., vol. x., p. 175.

SOCIETY AND CLUB NOTES.

MEETING OF THE N. E. COTTON MANUFACTURERS.

The extent to which electrical matters are forming an essential element in what are regarded as the more practical and commercial affairs is indicated by the list of papers to be read before the New England Cotton Manufacturers Association, which is to be held at Providence, R. I., on the 24th and 25th of April. These papers are: "Electrical Driving of Textile Establishments," by Sidney B. Paine, of the General Electric Company. "Operating by Electricity from a Distance," by John Eccles, Superintendent Ponemah Mills, Taftville, Conn. "Generation and Distribution of Electric Power for Manufacturing Purposes," by C. A. Stone and E. S. Webster, of the Massachusetts Electrical Engineering Company, Boston, Mass.

Among the topical questions which are propounded for general discussion is one, asking, "What is the comparative cost of arc and incandescent lighting?" It must not be assumed that this line of subjects breaks any precedent in this organization, which was founded thirty years ago, as electric lighting and power have been the subjects of frequent papers treating of the practical applications of electricity, beginning with a paper on electric lighting in mills read at the semi-annual meeting held in October, 1889.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The regular monthly meeting of Council was held at 26 Cortlandt Street, N. Y., April 17. The following associate members were elected: Jas. C. T. Baldwin, Superintendent Chicago Telephone Co., 203 Washington St.; residence, 1350 Washington Boulevard, Chicago, Ill. Francis Elliott Cabot, Supt. of Inspection and Electrician, Boston Board of Fire Underwriters, 55 Kilby St.; residence, East Milton, Mass. S. B. Fortenbaugh, Asst. Prof. of Electrical Engineering, University of Wisconsin, Madison, Wis. W. C. Harris, Jr., Electrician, Harris & Williamson, Birmingham, Ala. G. H. Jones, Agent General Electric Co., Casilla, 18 D Santiago; residence, Iquique, Chili. Charles LeBlanc, Chief Engineer Railway Department, Thomson-Houston Co., 27 Rue de Londres, Paris, France. Wm. E. Lindsay, Chief Engineer and Electrician, Swift & Co., National Stock Yards, East St. Louis, Ill. Paul N. Nunn, Consulting Engineer, San Miguel Cons. Gold Mining Co., Telluride, Colo. George Herbert Winslow, Electrical Engineer, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa. Total, 9.

The following associate members were transferred to full membership:—Albert Schmid, Superintendent, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. Omenzo G. Dodge, Professor of Mathematics, United States Navy, Washington, D. C. Charles Ashley Carus-Wilson, Professor of Electrical Engineering, McGill University, Montreal, Can. James A. Lighthipe, District Engineer, General Electric Co., San Francisco, Cal. Arthur Edward Childs, Electrical Engineer, Westinghouse Electric & Mfg. Co., Philadelphia, Pa. John Waring, Warner Electric Co., Ovid, N. Y. W. L. Puffer, Assistant Professor of Electrical Engineering, Mass. Institute of Technology, Boston, Mass. H. J. Ryan, Professor of Electrical Engineering, Cornell University, Ithaca, N. Y. Total, 8.

Mr. Geo. A. Hamilton was elected treasurer for the unexpired term of the late treasurer, Mr Geo. M. Phelps. At the meeting of the Institute in the evening President Houston officially announced the death of Treasurer Phelps with fitting remarks regarding his services in behalf of the Institute.

Mr. W. J. Hammer, Chairman of the special Committee appointed by the Council, made the following report which was accepted with a rising vote:

The Council of the American Institute of Electrical Engineers, desiring to express its sense of the loss to the Institute in the death of George May Phelps; at its meeting held Wednesday afternoon April 17th, 1895, at the Institute Headquarters appointed a special Committee of three to draft suitable resolutions which the undersigned as Committee respectfully present herewith.

Resolved: That in the death of George May Phelps, the Council has suffered the loss of an energetic, faithful, and capable member and the Institute, a most efficient officer; one who was constantly striving to uphold the standard of its work, one who was ever watchful of its welfare. In his disinterested efforts to serve the Institute he brought to bear upon its deliberations his keen perceptions, intellectual ability, and eminent force of character.

Resolved: That a copy of this resolution be suitably engrossed and framed and presented to Mrs. George W. Graham, his daughter and the sole surviving member of his family.

(Signed.) WILLIAM J. HAMMER, JAMES HAMBLET, RALPH W. POPE.

A paper by Prof. E. J. Houston and Mr. A. E. Kennelly upon "Resonance in Alternating Current Lines" was read by Mr. Kennelly and discussed by Mr. Bradley, Dr. M. I. Pupin and Prof. A. G. Webster.

A paper was also read by Prof. W. A. Anthony on "Underwriters Rules," which was discussed by Messrs. Hammer, Leonard, Woodbury, Jenks, Holmes, Mailloux, Ayers and Hamblet. A communication from Mr. Fremont Wilson was also read.

On occount of the lateness of the hour the final discussion of this paper was laid over until next meeting.

LITERATURE.

A Treatise on Industrial Photometry With Special Application to Electric Lighting. By A. Palaz, Sc. D. Translated from the French by G. W. Patterson, Jr., and M. R. Patterson. D. Van Nostrand Company. New York, 1894. 322 pp. 6 x 9. Price, $4.00.

WHILE we are still groping our way in the search for a practical standard of light satisfactory to all, or even to a majority, of the authorities on the subject, we must nevertheless have some standard to go by, and the knowledge necessary for getting the best work out of what is available is probably the next best thing, lacking the ideal apparatus.

The author, who represented Switzerland at the International Electrical Congress at Chicago, was a member of the Committee on Standards of Light, and has evidently given the subject much thought, presenting it in a manner which is well calculated to free it from the mistiness with which writers have frequently surrounded it in the past.

The fundamental principles of photometry are exceedingly simple, and in the present work the author devotes a short chapter to this part of the subject, which will give a very clear idea of the principles upon which photometric instruments are based, including the various actions of the light, the sensibility of the eye and its variations with the color of the light, together with the composition of the light emitted by various luminous sources.

The description of the various photometers proposed and in use next occupies the attention of the author, who has made a conscientious study of these various instruments and describes them in a most clear and concise manner. The illustrations accompanying this part are especially to be commended, as they give details and are not mere pictures. Under the head of "Photometric Standards" the author enters into a description and discussion of the various standards proposed and in use, which constitute an exceedingly valuable collection of data on this subject. In nearly all cases, we are glad to see, the original sources of information are given, which will enable the reader to verify the information or to extend the study of the subject. In the chapter devoted to the general equipment and auxiliary apparatus of practical photometry, the author describes the arrangements employed in actual practice for obtaining rapid results, including incandescent lampholders for obtaining the mean spherical power of incandescent lamps, the Vernon-Harcourt holophotometer, and the Rousseau radial photometer.

The chapter on electric lights treats of the subject in its various relations to the incandescent as well as to the arc lamp. There is no aspect of the case which the author has not touched upon, and the results of actual practice which he embodies in this chapter will be found of the highest value to those engaged in the manufacture of incandescent lamps, as well as arc light carbons, the influence of which on the amount of light emitted is well brought out here. The artificial light of the future is also touched upon in this section. A final chapter on the distribution and measurement of illumination closes the work.

Taken as a whole, the work must be highly commended, not only for the excellent matter which it contains and the manner in which it is presented, but for the discretion which the author has exercised in omitting much that would be included in a purely historical work, but which is of little value to one who wishes to get at the actual results obtained in practice in this department.

LETTERS TO THE EDITOR.

AN UNEXPLAINED DEATH FROM A 280 VOLT SHOCK.

A recent accident in the mines of the Leavenworth Coal Co., in which the Carr electric mining machines are employed has so prejudiced the miners against the use of these machines that I venture to lay before your readers the facts in the hope that some explanation may be forthcoming. One of the laborers was recently killed, apparently by an electric shock received while handling the machine, notwithstanding the fact that the E. M. F. on the circuit does not exceed 280 volts. Continued efforts failed to restore animation although the current was shut off immediately, but without success. A post mortem examination by physicians showed that the heart and brain and indeed the entire body was sound and no marks were present to show the cause of death. We are at a loss to know how 280 volts could have caused the man's death, as a number of others received the shock at the same time, and prior to the accident many have received the full extent of the E. M. F. As the deceased was a strong, well-built man we would be greatly indebted to some of your expert readers for an explanation of this most obscure accident.

W. J. E. CARR, M. E.

LEAVENWORTH, KAN.

[We will be glad to print any communications throwing light on this unfortunate occurrence. EDS. E. E.]

THE BRUSH STANDARD ARC SWITCH BOARD.

The standard Brush arc switch board, shown in the accompanying engravings, is a panel board with four circuits and four dynamos to a panel. The circuits are at the top of the panel, and the dynamos are at the bottom ; the positive terminals are above the negatives in each case, and each terminal has two plug receptacles for plugs, making it possible to insert jumpers, and change over, without opening circuits.

In the middle of each panel are ten plug receptacles, which

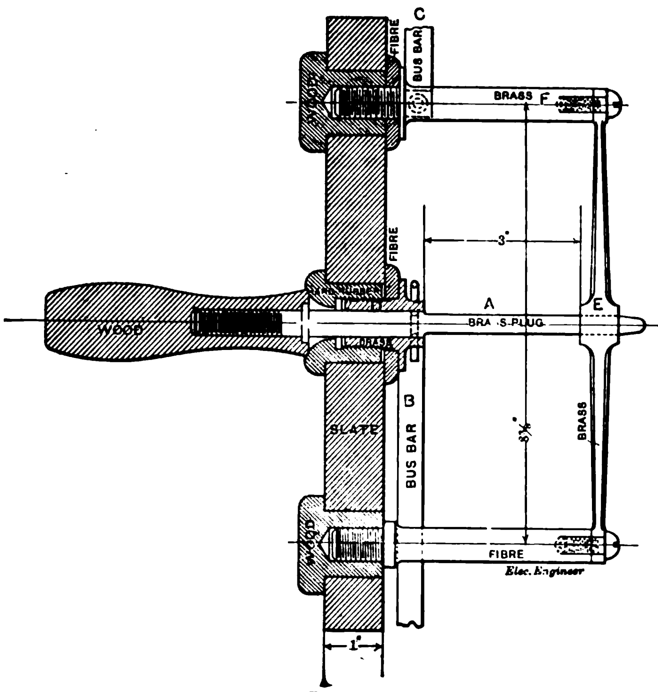


FIG. 3.

connect to bus wires running the length of board. These bus wires are used to connect from one end of the board to the other without running the cables back and forth as it is only necessary to connect the dynamos straight up to a circuit, thus leaving all the cables on the board straight up and down, instead of a confused network as is usual in front of arc switch boards. At every three panels or 12 circuits there is a bus wire, connecting the panel by means of which one can connect the bus wire continuously across the whole length of the board, or sub-divide as circumstances require.

The ground detector panel for this board consists of a Weston voltmeter, a multiplying coil, and a three way switch, by means of which the voltage of the whole machine or the voltage from either side to the ground, can be read, and from the relative proportion of the two one can readily locate a ground with great accuracy.

The panels are of slate, and are finished handsomely in black enamel. All receptacles and fittings are in the back of the board, making it impossible to receive a shock from the front side. In these receptacles, the arc is confined to the inside, thus making it impossible for the arc to jump from one terminal to another and cause trouble.

The plugs are provided with lava tipped rubber shields, which are thrown over the end of the plug by means of a spring, the instant that the plug is removed, making it impossible for an attendant to receive a shock from it, or to cause trouble by being carelessly thrown around the floor.

All parts of the board are insulated from the slate, making use in no case of the slate as an insulator. The board is furnished with either a wood or iron frame, as desired, and in either case is

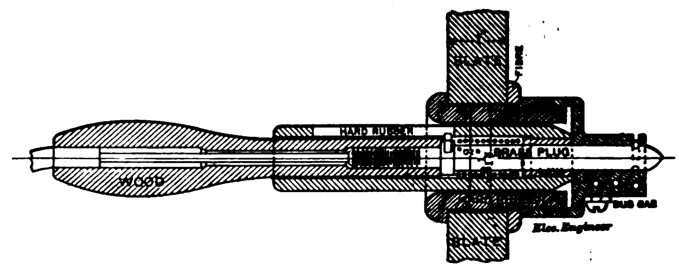


FIG. 2.

easily enlarged as nothing has to be cut or altered in order to add to the board.

Special attention has been given to the design of the plugs and sockets, Fig. 2 showing their construction. The plug as will be seen is provided with a hard rubber sleeve to cover the brass plug when the circuit is broken in switching.

The plug Fig. 3 is designed to make the connection from bus bar to bus bar when the circuit is to be carried more than 12 circuits away from the dynamo ; that is, in a 24 or 36 circuit board, there would be three places where a small panel is placed between the board, to divide the bus bars, and the plug shown in Fig. 2 is provided to make the connections in case it be desired to put dynamo No. 1 on circuit No. 24.

MR. F. S. KNIGHT, who, for the past four years has been superintendent of the electric light station at Chambersburg, Pa., has resigned his position to accept the position of superintendent of the Citizens' Electric Illuminating Company in Pittston, a city of 20,000 persons in Luzerne county. Mr. Knight, while superintendent of the Chambersburg plant added greatly to its efficiency, and his departure from that town is much regretted.

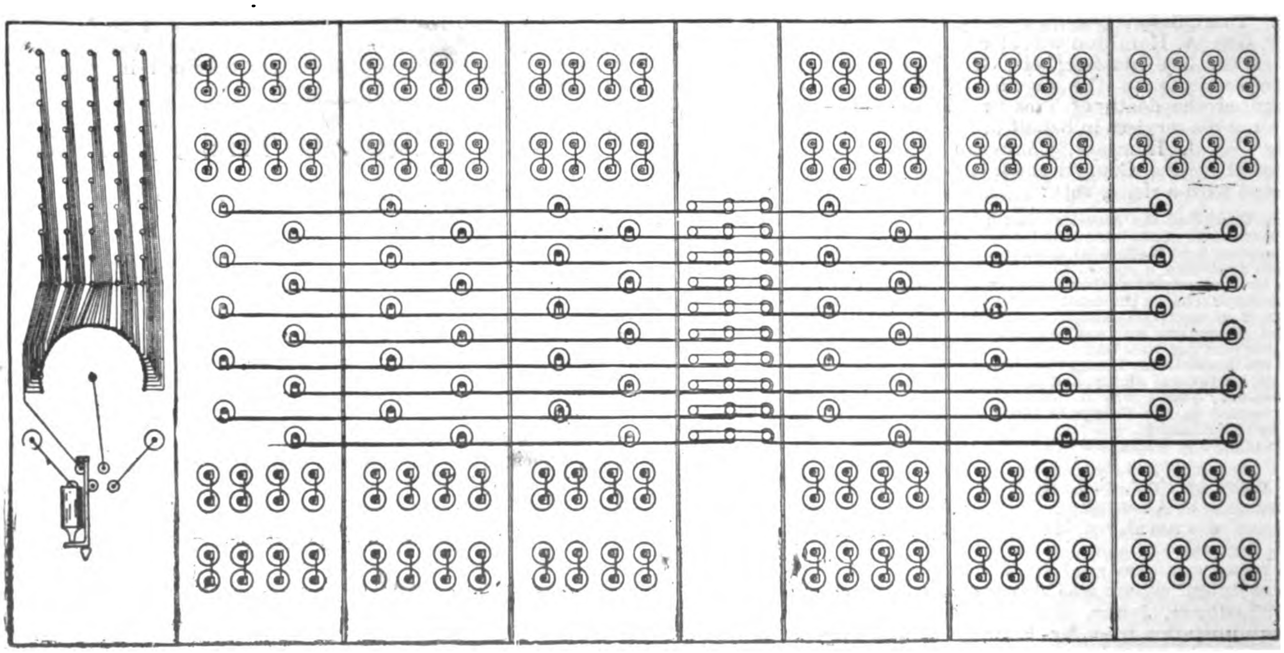
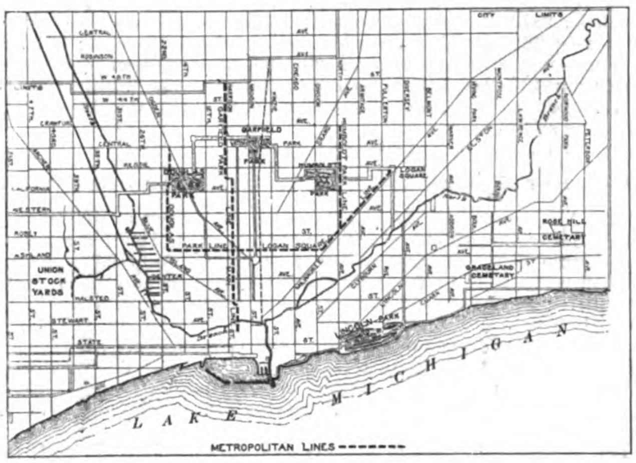


FIG. 1.—THE BRUSH STANDARD ARC SWITCHBOARD.

ELECTRIC TRANSPORTATION DEPARTMENT.

OPENING OF THE METROPOLITAN ELEVATED RAILROAD, CHICAGO.

The Metropolitan Elevated Railroad, the first electric elevated road in Chicago, was formally opened on April 17. The road is not yet ready for regular traffic, but it is the intention of the company to open it to the public about May 1.



MAP OF THE CHICAGO METROPOLITAN SYSTEM.

This road, it will be remembered, is to be operated similarly to the Intramural railway at the World's Fair. The motor cars, which were built for the company by the Barney & Smith Car Co., of Dayton, Ohio, necessarily differ in many respects from those ordinarily used either on surface or elevated roads. One of these cars is shown in the cuts. The principal feature of the car is the steel sub-frame, which was added to enable the car to pull six loaded, 40-foot trailers, and also to get sufficient weight for traction; for the latter reason no attempt has been made to lighten the construction of the car body and trucks.

The car weighs nearly 40,000 pounds without electric apparatus of any kind. The body is 40 feet long, while the steel frame is 47 feet 8 inches. The entire height from rail to roof is 12 feet 10 inches, the width at the sill is 8 feet 7 inches, and that at the eaves is 8 feet 11 inches.

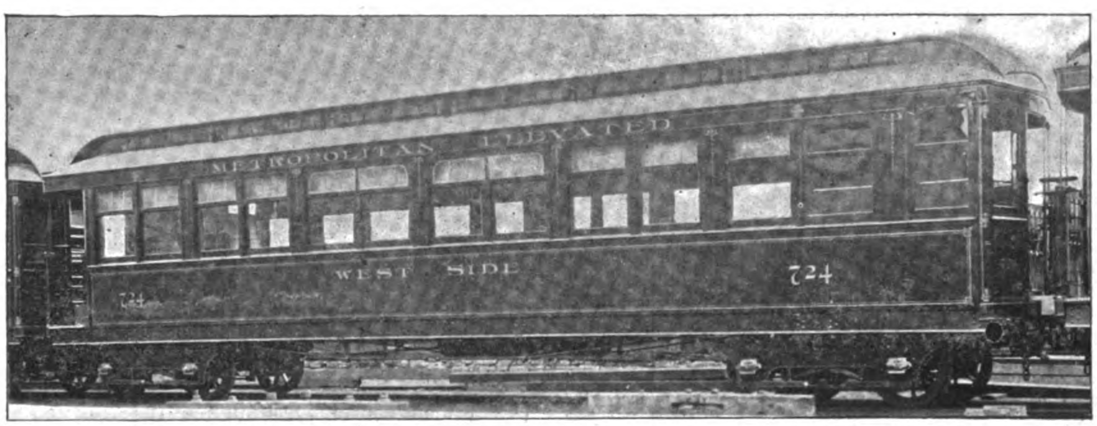
The end sills are of oak, and the six longitudinal sills and stringers are of long leaf yellow pine. The end frames have iron plates at the sill and uprights to prevent telescoping in case of collision.

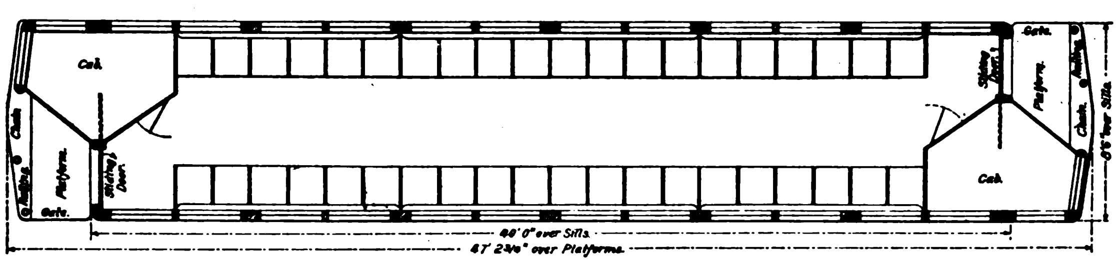
There is a motorman's cab at each end, diagonally opposite each other, extending out on the platform as far as the end of the hood. The entrance doors are, therefore, next to the corner posts, and slide back into the cabs, as shown in Fig. 2. As the front door is always to be kept fastened, this will not inconvenience the motorman.

The cars are handsomely finished within in quartered oak, and are lighted by incandescent lamps placed directly above the seats. Electric heaters will be used in the winters. They are also equipped with quick acting air brakes, the air being carried in storage tanks under each car.

The first train to carry other persons than officials made its trip successfully over the Metropolitan "L" road on the 17th inst. The northwest branch of the road is complete to Wicker Park and to this point the special Pullman train was run. The run from Canal street to Paulina street was made in five minutes. There the main line of the road, which carries four tracks, ends, and the Garfield Park, Douglas Park and Logan Square lines begin. The Garfield Park line extends to Forty eighth street. The Douglas Park line extends from the terminal of the main line south to Twenty-first street, and thence past Douglas Park to Central avenue. This branch is not yet completed. The Logan square line extends from the terminal of the main line north to Milwaukee avenue and Division street, and thence northwest, parallel with Milwaukee avenue, to Logan square. The Humboldt Park line branches off the Logan square line at Robey street and North avenue, and will extend west to Crawford avenue when completed. The Logan square line penetrates one of the most densely populated districts of the west side and will draw its patronage largely from the Polish quarter.

These various lines contain miles of track as follows: Main line, 1.8 miles; Garfield Park line, 4.2 miles; Douglas Park line, 3.7 miles; Logan Square line, 4.49 miles; Humboldt Park line, 2.13 miles. The various lines contain forty-three stations.





EXTERIOR AND PLAN OF METROPOLITAN CAR.

The Metropolitan line will run 155 cars—100 passengers and 55 motors.

There are two impressive pieces of engineering—one the bridge on the Logan Square line, which carries the elevated tracks over

the Northwestern Railway tracks and has a span of 250 feet. The method by which the Metropolitan tracks are carried over the Lake Street "L" tracks also presents an interesting feature of engineering.

In addition to reporters for all daily newspapers, representatives of the electrical, street railway and other technical papers were present. Among the road's officials present were Robert E. Jenkins, president; Geo. Higginson, Jr., the secretary; W. E. Baker, general superintendent; W. W. Gurley, general counsel; E. J. Harkness, attorney; H. M. Brinkerhoff, electrical engineer; A. S. Jones, sup't. of transportation; and A. L. Gardner and E. L. Lobdell, directors.

TROLLEY LINES IN CONNECTICUT.

The railroad committee of the Connecticut Legislature has reported favorably a bill establishing the same system of fares on Sundays as on secular days in that state upon steam railroads.

The same committee has decided to consider each application for a trolley road charter on its merits, and without special regard to paralleling of steam roads. This is a defeat for the steam railroad companies of the state, which asked a general rule in relation to parallels.

THE COMPETING TROLLEY ROAD BETWEEN BUFFALO AND THE FALLS.

The electric road between Buffalo and Niagara Falls is to be built of 94 pound steel girder rails, with side trolley poles. It is to be double-tracked except for a distance of 2½ miles, where the highway commissioners of the town of Wheatfield refused to grant more than a single-track line franchise. It will give Buffalo and Niagara Falls cheap fares, the rate to be but 50 cents for the round trip. Quick time is to be made, and in order to do this the road is to be made so that heavy cars can be used. The power for operating the road will be furnished by the Niagara Falls Power Company, and according to the contract, the cars will be running by July 1 of this year.

All the capital for the building of this road has been secured and the moment the weather permits, work on its construction will begin. The first section between Buffalo and Tonawanda will, it is said, cost about $500,000 complete.

W. Caryl Ely is one of the chief promoters, and is a well-known Niagara Falls citizen and official.

THE NIAGARA GORGE ROAD.

Work is being actively pushed in connection with the proposed road through the Niagara River Gorge, passing close to the water's edge all the way down, passing the Whirlpool Rapids and other points. Capt. J. M. Brinker, of Buffalo, is giving close personal attention to the preparatory steps.

Crage & Tench, the general contractors, of Buffalo, write us that they have closed a contract for the construction of seven miles of double track road. Their headquarters are at 2399 Niagara street, Buffalo, but they have opened a branch office for this work at the Tower Hotel Block, Niagara Falls, N. Y., where they are pushing things with great vigor. The line will extend all the way from Niagara Falls to Lewiston.

A TROLLEY FROM NEW YORK TO ATLANTIC CITY.

News comes from Atlantic City, N. J., that a syndicate of New York and Atlantic City capitalists has organized a company which is to be capitalized at $4,000,000, to build an electric railroad from New York to Atlantic City. If the scheme proposed goes through, the road will be in operation during the coming Summer. This is the same company which is building electric roads in and about Baltimore and Washington.

OVERHEAD WIRES IN CINCINNATI.

The first annual report of the Cincinnati City Electrician shows an encouraging state of affairs, but the need of proper electrical legislation is evident. In the first place there are too many overhead wires. The city electrician recommends the appointment of two inspectors under him until such time as the wires are underground. There are fifty miles of live wires strung in the city without a franchise. He recommends that the grantee of the route of the old Cincinnati Inclined Plane Railway company use a double-trolley system, or a single-trolley system with heavier poles. There are 15,485 poles of electric companies in Cincinnati which should be taken down. They carry 8,815 miles of feeder wires, which, the report states, should go underground.

KNOXWILLE, TENN.

THE KNOXVILLE, TENN., ELECTRIC RAILWAY CO.'s system, rolling stock, franchise, etc., are to be sold on May 24, according to notice given by Mr. J. C. Duncan, special commissioner for the U. S. Circuit Court.

LEGAL NOTES.

WESTERN ELECTRIC CO. VS. J. H. BUNNELL & CO.—TELEPHONE DECREES.

Final decrees were obtained at the April Term of the U. S. Circuit Court, Chicago, in three suits brought against J. H. Bunnell & Company, of New York City, by the Western Electric Company, for infringement of the various patents covering the several features of its magneto call-boxes. Substantial damages were awarded in each case, and perpetual injunctions granted, enjoining the defendants from making or selling magneto call-boxes or telephonic apparatus embodying these inventions as they appear in the following patents: No. 270,522 for telephone switches; 287,873, for the automatic crank-switch in telephone call boxes; 221,434, for spring hinges for telephone cases; 231,790, for magneto-electric generators; 203,495, for telephone call signal apparatus; 210,886, for polarized armatures for electric bells; 309,617, for improvements in telephone call-boxes, and 266,374, for telephone switches.

APPEAL IN THE BERLINER PATENT CASE HEARD IN BOSTON.

The American Bell Telephone case, which was tried in the United States Circuit Court some months ago, and which resulted in a decree being entered in favor of the United States against that company, to the effect that the patent granted on the Berliner transmitter be given up and canceled, came up on appeal last week, before Judges Colt, Putnam and Nelson, in the U. S. Circuit Court of Appeals, Boston. The Government lawyers are Robert B. Taylor of Indiana and Causten Browne. The American Bell Telephone Co. is represented by William G. Russell, James J. Storrow, W. W. Swan, Frederick P. Fish, and W. R. Richardson.

The facts in the present case are as follows: Nov. 17, 1891, the United States issued to the defendant corporation, as assignees of Emile Berliner, and on his invention, patent No. 463,569, duly signed and sealed, for that kind of telephone transmitter known as the speaking microphone.

This bill alleges that the patent is for the broad invention of the constant contact telephonic transmitter, and that its claims cover this invention; that this invention proved immediately upon practical introduction of the art of telephony to be of great value, and that instruments which embody it are the only instruments capable of successful use to meet modern commercial requirements, and that the patent, if it is valid, will give to the inventor and his assignees the practical monopoly of said invention.

The bill also sets forth various allegations and prayers that the court will either cancel the patent entirely or will treat it as a contract to be reformed.

The Circuit Court, on Jan. 3, 1895, entered a decree that the patent be entirely canceled, resting its decision upon two grounds:

First—That the patent is void as being beyond the power of the Commissioner to issue, in view of a former patent, No. 233,969, issued Nov. 2, 1880, to the Bell Telephone Company, as assignee of Berliner.

Second—The patent in suit was applied for on June 4, 1877, and issued on Nov. 17, 1891. The Circuit Court found that the first five years of this time constituted no delay greater than is usual in the Patent Office, and that nothing during that period justified a decree for the plaintiffs. It found also that after that time there was more or less unwarrantable delay in the issue; that the Bell Company intended this delay, and should be held in law accountable for it, and thereupon the court decreed a cancellation of the entire patent.

Argument continued throughout the week and was brought to a close on Saturday.

RIES SHAREHOLDERS MUST PAY UP.

An order has been signed by Judge Wickes, in Circuit Court No. 2, Baltimore, Md., directing Bernard Wiesenfeld and Sylvan Hayes Lauchheimer, receivers for the Ries Electric Specialty Company, to call upon the stockholders of the company for the unpaid installments of the capital stock issued to them. These payments are necessary in order to pay the indebtedness of the company.

INTERIOR CONDUIT MAY ISSUE ITS GOLD BONDS.

Justice Beach, in the N. Y. Supreme Court has handed down a decision in the case of Franz Merz and others against the Interior Conduit and Insulation Company, in which he refuses to make permanent a temporary injunction issued by Justice Beekman to restrain the officers and directors of the company from issuing $500,000 worth of gold debenture bonds.

TELEPHONY.

THE PHŒNIX INTERIOR TELEPHONE CO.'S APPARATUS.

The enormous demand for telephones in buildings, for private lines between points a short distance apart and in small exchanges, has called forth a variety of apparatus, and the most recent concern to enter the field is the Phœnix Interior Telephone Co., of 131 Liberty St., N. Y. This company has a well equipped shop and is manufacturing a variety of styles of telephones, a few of which we illustrate in the accompanying engravings. Fig. 1 shows its standard Blake transmitter wall set adapted for both long and short line work, and Fig. 2 the same transmitter, but without battery box or backboard. This latter type is particularly adapted for interior work where the distances are over 200

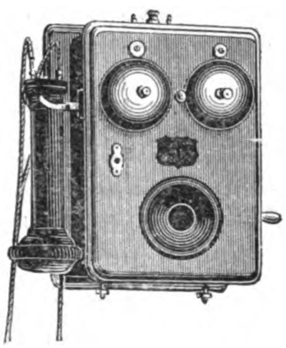


FIG. 2.

FIG. 4

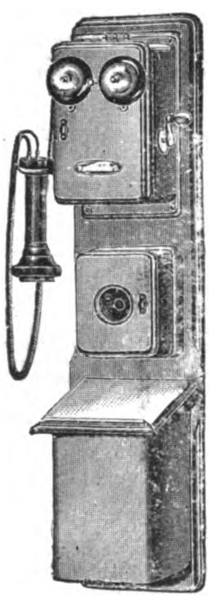


FIG. 1.

FIG. 3.

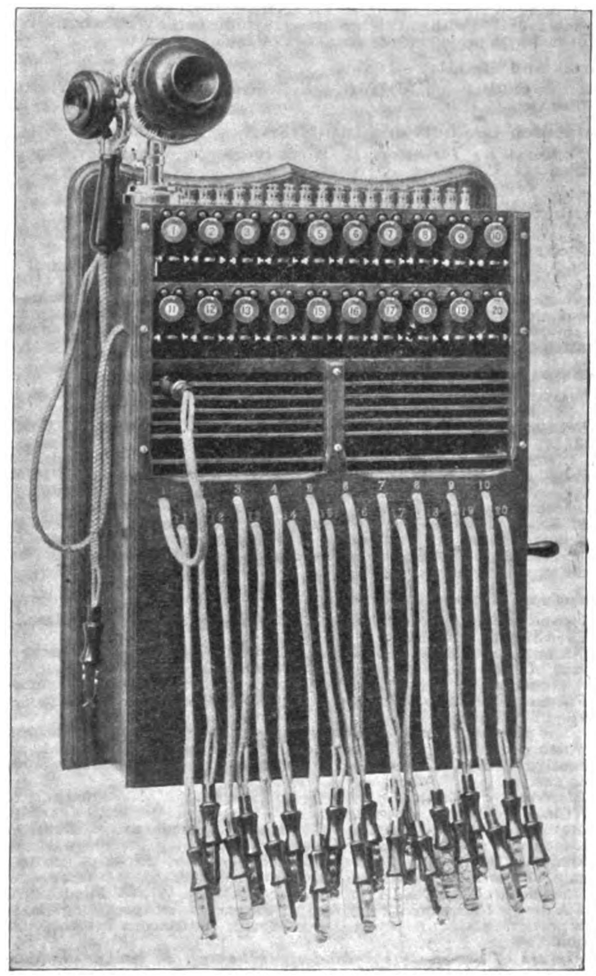


FIG. 5.

THE PHŒNIX INTERIOR TELEPHONE CO.'S APPARATUS.

feet, the battery being placed in some convenient place near the instrument. Fig. 3 shows the Phœnix desk telephone mounted on a brass standard, so arranged that either magneto bell or battery call bell can be used for signalling.

A special feature of the Phœnix system is the independent switch system, the switch being illustrated in Fig. 4. This gives the business manager control of any desired number of subordinates. Where it is desired to afford communicatiou between parties at different stations indiscriminately, the board shown in Fig. 5 is employed, which is well adapted for small exchange work and is claimed to be non-infringing in every particular. In this board the horizontal strips shown consist of brass ribbons separated by fibre insulation, each strip constituting a continuous terminal and taking the place of the loops from one terminal to the same number on another section in the multiple switchboard. The board illustrated is arranged for 20 drops, and 5 conversations can be carried on at the same time. It is so arranged that it can be readily extended for future increases.

All the above apparatus is well built, and it is now being rapidly introduced.

A BANQUET SPEECH IN ENGLAND BY TELEPHONE.

At the recent annual dinner of the National Telephone Co. Ltd., in London, Mr. J. Staats Forbes, the chairman of the company, who was ill at Folkestone, sent his speech by telephone from his sick bed, speaking directly by means of head instruments to the presiding officer and the reporters; and receiving the response and applause in like manner. The episode was very interesting and went off most successfully.

THE TELEPHONE AS A "BUNGHOLE OF OBLIVION" AT BURLINGTON, IA.

Information comes from Burlington through the press that the Iowa Union Telephone Company will within a very short time have nothing further to do in Burlington than to howl "hello" into the voiceless bunghole of oblivion. The new telephone company organized there has to date 225 subscribers, including all but thirty-five of the old company's patrons. The new company expects to get the remaining thirty-five, together with about 200 new subscribers in the residence portion of the city. The men behind the movement have plenty of capital and business ability. They are the Walsh brothers of Clinton, owners of the Burlington electric light, steam supply and electric railway plants, and Col. G. H. Higbee, president of the Murray iron works. It is announced that Mart J. Higley, formerly secretary of the Cedar Rapids Cold Storage Company, has joined the new telephone company, and will remove to that city at once. The new company is making contracts at $20 a year, cutting the old company's prices in half.—*Davenport, Ia., Leader.*

CUERO, TEX.—The Cuero telephone company has been formed; capital stock, $4000; incorporators, Wm. Frobese, C. L. Stadtler, Wm. Wagner, Lee Joseph, W. R. Rothbone, D. Hunter.

SO. NORWALK, CT.—The South Norwalk Telephone Equipment and construction company has purchased the electric time service in this city.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 16, 1895.

Accumulators:—

Secondary Battery, W. M. McDougall, East Orange, N. J., 537,474. Filed Jan. 7, 1893.

Claim.—In a storage battery, a perforated box or envelope of non-conducting material in combination with a flat electrode located inside the same and provided throughout both its surfaces with a plurality of laterally projecting lugs bearing against the inside walls of the box or envelope for the purpose of maintaining it in a central position therein.

Secondary Battery, W. M. McDougall, East Orange, N. J., 537,475. Filed Aug. 2, 1894.

Claim 2.—The combination with a secondary battery electrode, of an envelope of the same consisting of elastic material, the normal size of which is smaller than the electrode, so that it will have to be stretched to embrace the electrode, the sides of the envelope being perforated.

Glass Vessel for Secondary Batteries, Etc., H. Kroeker, Berlin, Germany, 537,575. Filed April 22, 1893.

Claim.—A rectangular vessel for accumulators having two internal parallel walls provided with parallel grooves extending to the bottom of the vessel and formed with projections or shoulders on their top.

Alarms and Signals:—

Railway Block Signal Lock and Register, J. Dean, New York, 537,757. Filed Oct. 26, 1894.

Conductors, Conduits and Insulators:—

Electric Wire Insulator, D. M. Rothenberger, Lancaster, Pa., 537,718. Filed Jan. 8, 1895.

The insulator has imbedded in it the tie wire.

Distribution:

System of Electric Distribution, E. W. Rice, Jr., Swampscott, Mass., 537,549. Filed Feb. 21, 1894.

Claim 1:—In a system of distribution of electric energy, central stations equipped with sources of continuous current and with sources of alternating, sub-stations adapted to convert alternating current into continuous current, and alternating current feeder lines connecting the main stations and the sub-stations together, in combination with mains adapted to supply translating devices connected to all of the stations.

Dynamos and Motors:—

Commutator, G. E. Painter, Baltimore, Md., 537,480. Filed Feb. 28, 1895.

For description see page 372 this issue.

Regulator for Dynamo Electric Machines, W. S. Moody, Lynn, Mass., 537,541. Filed Aug. 30, 1893.

Claim 1:—In combination, an alternating current dynamo-electric machine, separate exciting dynamos therefor, a magnetic device in shunt to the main circuit responsive to changes in the line potential, a switch operated thereby and adapted to vary the field strength of the exciters, substantially as herein described, and a second magnetic device in series in the main circuit adapted when the load is increased to oppose the potential reducing effect of the first magnetic device, and thus to compound or over-compound the regulating effect.

Lamps and Appurtenances:—

Incandescent Electric Lamp, E. Thomson, Swampscott, Mass., 537,498. Filed May 22, 1893.

A bulb for an incandescent lamp, having a screw threaded neck, forming part of the exhausted air chamber, and a supporting tube connecting with the outer end of the neck, and projecting into the exhausted chamber.

Filament and Carbon for Electric Lamps, P. Stiens, London, Eng., 537,555. Filed Feb. 14, 1895.

The process of treating filaments or carbons in the course of manufacture, which consists in impregnating them with burned boric acid, and then heating them by the electric current in the presence of carbonaceous vapor or gas.

Electric Arc Lamp, C. A. Pfluger, Chicago, Ill., 537,617. Filed July 2, 1894.

Claim 1.—An arc lamp comprising a carbon holder with a carbon free to move therein, stops to limit the motion of said carbon, said stops being attached to pivoted arms, said pivoted arms having pivoted washers associated with their ends so that the distances between the stops are fixed when said washers are in place but may be varied when the washers are removed.

Electric Arc Lamp, E. H. Crosby, Boston, Mass., 537,633. Filed Aug. 13, 1894.

A device for automatically feeding the carbons and providing a lamp which is portable and can be inverted or used with the carbons in a horizontal position.

Process of Evacuating Incandescent Lamps, A. Malignani, Idine, Italy, 537,693. Filed Aug. 15, 1894.

Consists in first introducing into a tubular elongation of the bulb substances capable of being gasified by heat and combining with the gases generated by the filament when brought to incandescence to form solid or liquid precipitations.

Electric Arc Lamp, L. C. H. Mensing, London, Eng., 537,696. Filed Oct. 29, 1894.

Measurement:—

Electric Measuring Instrument, E. Thomson, Swampscott, Mass., 537,499 Filed Oct. 26, 1894.

Claim 1.—In an electric measuring instrument, a pair of magnets having their poles reversed with reference to each other, a flat coil or coils rotating between such poles against an opposing force, and an index actuated by the coil.

Electric Measuring Instrument, E. Thomson, Swampscott, Mass., 537,500. Filed Oct. 26, 1894.

Adapted for the measuring of current, working upon the astatic principle, thus making it adaptable to station switch-boards and other places where stray fields are apt to affect the correctness of instruments of ordinary construction.

Electric Measuring Instrument, E. Thomson, Swampscott, Mass., 537,501. Filed Oct. 26, 1894.

Claim 2.—In an electric measuring instrument, a pair of magnets having one pair of their poles of like sign adjacent to one another, a curved pole piece connecting such poles, a second curved pole-piece connecting the other pair of poles of like sign, and a coil moving in the space between the two pole-pieces.

Electric Meter, H. T. Harrison, London, Eng., 537,769. Filed June 14, 1892.

The electrical energy to be measured, is caused to increase the amplitude of a pendulum the number of swings whereof per minute is kept constant, and the increase of amplitude is registered.

Miscellaneous:—

Electrical Interrupter, G. J. Anderson, Brooklyn, N. Y., 537,595. File Feb. 18, 1895.

A revolving commutator of special construction.

Railways and Appliances:—

Electric Railway Conduit System, H. A. Belden, Washington, D. C., 537,686. Filed Jan. 26, 1895.

A conductor support for suspending the conductors in railway conduits from above allowing of universal adjustment.

Electric Railway Conduit System, A. N. Connett, Washington, D. C., 537,690. Filed Jan. 26, 1895.

For description see THE ELECTRICAL ENGINEER Feb. 6, 1895.

Electric Railway, J. Claret and O. Wuilleumier, Lyons, France, 537,672. Filed Sept. 19, 1894.

Details of road construction for conduit railways to provide for conditions at crossings and junctions.

Electrically Actuated Vehicle, J. B. Clark, St. Paul, Minn., 537,673. Filed March 3, 1894.

A locomotive in which current is derived from a generator operated by a gas engine mounted on the locomotive.

Sectional Conductor for Electric Railways, J. F. McLaughlin, Philadelphia, Pa., 537,706. Filed Feb. 5, 1895.

With this arrangement but one switch is necessary to each section of the working conductor, and but two magnets are needed on each car, one near each end of the same.

Safety Support for Overhead Electrical Conductors, A. D. Poole, Boston, Mass., 537,715. Filed Aug. 13, 1894.

The breaking of the wire automatically breaks the circuit at the section insulator.

Switches and Cut-Outs:—

Combined Cut-Out and Lightning Arrester, M. J. Wightman, Scranton, Pa., 537,513. Filed Jan. 9, 1895.

Claim 2.—In a combined cut-out and lightning arrester, a line circuit, cut-out terminals therein, lightning arrester terminals, and means for generating a magnetic field adjacent to each set of terminals, consisting of an electro-magnet in the line circuit, having a central core and a separate pole of the same sign under each pair of terminals.

Electric Switch, J. J. Wood, Fort Wayne, Ind., 537,515. Filed Nov. 12, 1894.

An improved snap switch.

Electric Switch, E. M. Hewlett, Schenectady, N. Y. 537,583. Filed Dec. 22, 1894.

The object of the invention is to automatically reverse the leads to a current indicator, at the instant the feeder switch is thrown from the negative bus-bar to the positive or vice versa.

Electric Switch, A. Metzger, Schenectady, N. Y., 537,588. Filed Oct. 5, 1892.

Details of construction.

Electric Switch, A. Metzger, Schenectady, N. Y., 537,589. Filed Apl. 15, 1893.

Claim 1:—In a knife blade electrical switch, a circuit terminal consisting of sheet metal vertical arms or clips formed with oppositely overlapping base portions, the latter being provided with an extension projecting from the base for attachment of the circuit wire.

Electric Switch, H. P. Ball, Bridgeport, Conn., 537,665. Filed Oct. 19, 1894.

The joint embraces a pivot bearing in the edge of each blade in the form of a sector of a circle and a conducting ring located in the section of a circular groove.

Telephones:—

Automatic Telephone Exchange System, W. Decker, Owego, N. Y., 537,662. Filed May 14, 1894.

Claim 1.—In an automatic telephone exchange system, the combination of a backward and forward moving intermittent circuit closer for producing intermissions of currents during its backward movement only, means for stopping the circuit closer at any one of several predetermined positions during its backward movement, and a stop located at the normal position of the circuit closer for stopping said circuit closer at the end of its backward movement.

Telegraphs:—

Printing Telegraph, O. L. Kleber, Pittsburg, Pa., 537,464. Filed June 5, 1894.

Telegraphy, R. H. Morris, Roselle, N. J., 537,644. Filed Aug. 10, 1894.

In a telegraph system the combination of a neutral relay and a current-reversing key at the same station, said neutral relay being provided with oppositely wound coils which are joined one with a positive and the other with a negative generator.

FINANCIAL.

ELECTRICAL SECURITIES.

While speculation has been brisk during the past week, and while the demand for three or four main staples of trade has added over $200,000,000 to the value of existing stocks on hand, it cannot be said that any marked improvement or inquiry is yet seen in electrical securities. It is generally believed, however, that a rise is at hand; while the briskness in the electric railway and telephonic fields betokens a growing bulk of business in many lines of supplies. The tone is more cheerful than it has been for months past.

During the week, 79,678 shares of General Electric were sold on the New York Exchange. The highest price was 34¼; the lowest, 31¾; the closing, 33⅝. Of Western Union, 17,808 shares changed hands, up to 89, a gain of ⅞. In Boston, Bell Telephone worked up again to 188 but settled down to 180. It is evident that many holders are parting with their property, but strong believers in the future of telephony wait for it. Westinghouse preferred closed on Saturday at 52 and the common at 34.

Local electrical securities everywhere through the week were firm and steady, gaining several points in some instances. It is too late for lighting companies to pick up much new business; but the street railways report many handsome gains in revenue.

The New York *Sun* came out last week with a carefully prepared article endeavoring to ridicule the idea of any General Electric-Westinghouse negotiations. In some quarters it is believed that the article was inspired; and some allege that it was aimed at one man.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NOLL & SIBLEY.

The firm of Noll & Sibley, composed of Frederick Noll and C. C. Sibley, has been formed to deal in electrical supplies, as manufacturers' agents, and it has taken commodious quarters in the Postal Telegraph Building on Broadway and Murray street, New York. Both gentlemen are well-known in the electrical field. Mr. Sibley had charge of the lamp sales department for the Edison Electric Illuminating Co. of this city, and later filled the same position with the New York Electrical Equipment Co. Mr. Noll has been superintendent of supplies and purchasing agent for the Equipment Co. Their work and connection with the electrical business dates back, however, many years and has been in touch all the time with all its developments.

One of the most important features in the new firm's work is the fact that it has been appointed by the General Electric Co., sales agents for Edison lamps and the G. E. supplies for New York city. These alone represent a large element of business, and will keep the concern busy, aside from other important agencies. Noll & Sibley start on their career with the good wishes of a host of friends. Their telephone call is "2169 Cortlandt."

THE MANHATTAN ELECTRIC STORAGE BATTERY COMPANY.

Electricity distributed from central stations has been applied to a large number of purposes, but the growing number of isolated electric plants indicates the unmistakable trend towards the desire of consumers to have plants under their immediate control, both in the interest of economy and the independence which such a plant affords. But the great drawback to the larger number of isolated plants has been the fact that in order to have current constantly available, the plant had to be kept in operation whether one ampere was required or 500, necessitating the expense of fireman and engineer constantly on duty, and to this must be added the not unimportant fact that a plant operated at light load is exceedingly wasteful of coal.

As a remedy for this evil, the storage battery naturally suggests itself. Take the case, for instance, of a large store operating during the busy hours of the day, say, 1,000 lamps, and requiring 200 or 300 lamps for the illumination of show windows at night when the store is closed. The addition of a storage battery plant having sufficient capacity to carry this load for four or five hours would entail but a small expense compared with the saving effected by the cutting down of the dynamo attendant and in the coal bill. All that would be required would be the throwing of the switch by the watchman when the time for extinguishing the lamps arrived.

Or, take the case of a building, such as a large hotel or apartment house, in which the number of lights required after midnight is reduced practically to a few hall lights, and those in the hotel office; large economy could be effected by installing a storage battery. But another important gain could be effected by operating the elevators by means of current from the same battery. At present it is necessary to run the entire dynamo and hydraulic elevator plants continuously day and night, but with the storage battery, the entire steam plant could be shut down, say, at midnight until seven in the morning. Calculation shows that a storage battery has an energy capacity for operating the elevators for 20 times as many trips as a water pressure tank of the same cubical capacity.

What is true as regards wastefulness in isolated plants at light loads holds even more so in the case of central stations, owing to the greater amount and initial cost of operating machinery lying idle during light loads. Europe has recognized this fact, as evidenced by the large number of storage battery plants installed there, but the merits of the storage battery adjunct to central stations is now gradually but surely being recognized in the United States, and the results obtained in Boston, New York and other places will go far towards inspiring confidence in their use.

But besides these larger applications, there is practically no limit to the applications of storage batteries where electricity is required in portable form, or in small quantities, where the installation of a plant would be out of the question. We need only cite the growing use among physicians of electrical appliances of all kinds requiring a handy source of current such as the storage battery affords. In telegraphy and telephony also, one storage cell has in some instances displaced 100 gravity cells.

One of the most recent applications of the storage battery is its employment in connection with bicycle headlights. The addition of a little over two pounds weight to the bicycle equipment in the form of a small battery puts at the disposal of the rider a 4 C. P. lamp operated for 12 hours. Only those who have had to contend with the annoyance of the oil lamp now in general use can appreciate the value of this cleanly and constant source of light. We might continue to enumerate the applications of the storage battery, but what has been said is sufficient to show its almost universal application.

Arrangements for installing a number of large isolated storage battery plants in some of the largest stores in New York City are now under way, and the work will be carried out by the Manhattan Electric Storage Battery Company, of 66 Broadway, who are the sole selling agents of the Chloride accumulator in the district of New York and vicinity, and are exploiting the entire storage battery field. The company is strongly organized, and its officers include some of the best known gentlemen in trade and finance, as follows: James H. Hoffman, president; Louis Stern, vice president; August Belmont, treasurer; Lewis May, secretary.

As affording strong testimony of the hardy nature of the Chloride accumulator, we print below a letter which speaks for itself:

Established 1831.

WASHBURN & MOEN MANUFACTURING COMPANY.

Works at
Worcester, Mass.
Waukegan, Ill.

Chicago Office,
107 & 109 Lake Street,
C. T. Boynton, Mgr.

Chicago, Ill., Feb. 15, 1895.

Messrs. Pierce & Richardson,
1409 Manhattan Building, Chicago, Ill.

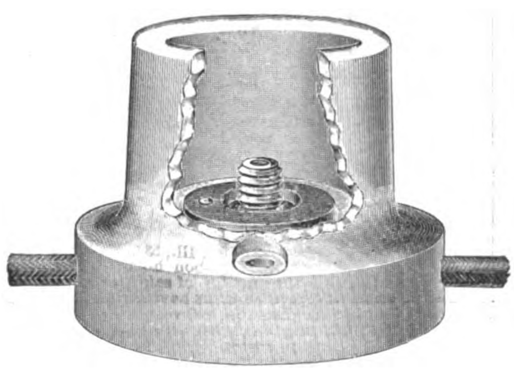
Gentlemen:—I wish to inform you of the highly satisfactory results obtained by me in the use of your Chloride Accumulator under conditions which I consider very trying. During the past five months I have used two 5 E cells in series, for heating to the melting point a short length of No. 14 rubber covered wire, practically short-circuiting the battery.

I have made this experiment fully 400 times, actual measurement showing an average discharge of 600 amperes for about one minute, or until the copper fused. The cells are now in as good condition as when new, not being buckled or disintegrated in the least. Considering that the normal discharge rate of these cells is but 10 amperes, I think this a remarkable record.

Very truly yours,
(*Signed*) Channing T. Gage.

BRYANT WEATHERPROOF SOCKET SIDE CONNECTION.

New fields in commerce develop new specialties. The increased popularity of exterior illumination and signs made by groupings of incandescent lights has created a demand for sockets of various descriptions. The Bryant Electric Co. has recently placed upon the market several weatherproof sockets, the latest being one with side connections. It is needless to cite



Bryant Waterproof Socket Side Connection.

the merits of the device which can be seen at a glance, and the reputation of the makers insures excellence in its manufacture. The Bryant Electric Co. has a most complete line of sockets for sign work, one of which is shown in the accompanying engraving. Grier Bros., managers of the Western Office, carry a full line in stock in the Chicago storerooms.

PHILADELPHIA NOTES.

Mr. Dale B. Scarborough, formerly with the Short Electric Co. and later with the Stearns Mfg. Co. has accepted a position as travelling salesman for Vallee Bros. & Co., of 617 Arch St.

Mr. W. H. Dresher, treasurer of the Electric Protector Co., of Philadelphia, gave his many friends a genuine but pleasant surprise by getting married last week to Miss C. G. Schaeffer. The wedding trip has been into the golden west.

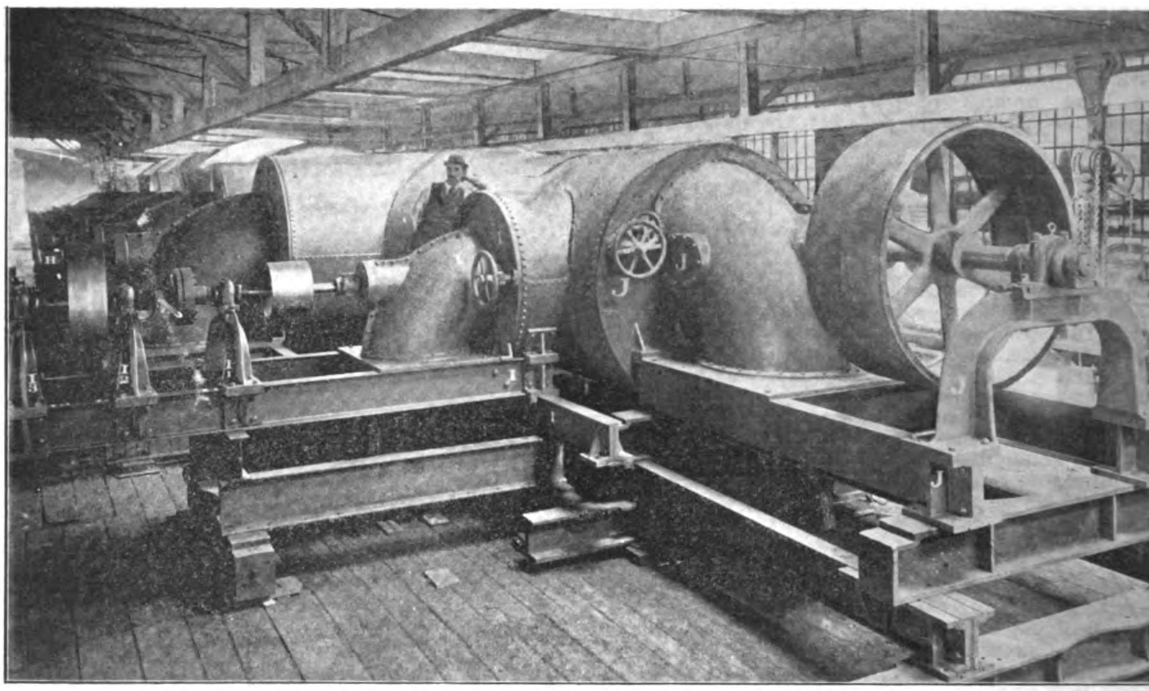
Mr. Frank H. Stewart, the enterprising electrical supply dealer of 20 No. Seventh street, has admitted Mr. P. Logan Backins as a partner, and the firm will be known hereafter as Frank H. Stewart & Co. They will act as agents for the Perkins Electric Switch Mfg. Co., Dayton Fan and Motor Co., Waterhouse-Gamble arc lamps and the Perkins Electric Lamp Co.

THE WISCONSIN ELECTRIC CLUB.

THE electrical men of Milwaukee are combined into the Wisconsin Electric club. The officers are: Thomas R. Mercien, president; Walter C. Smith, secretary, and W. H. Hyde, treasurer. The club meets every Friday at fine quarters in The Studio building on Third street, occupying these quarters jointly with the Architects' association and with the Association of Civil Engineers. Every other Friday evening a paper is read by some member on some electrical topic, and often specialists are invited to read papers before the club. It is as much an organization of a social nature as for the promotion and diffusion of electrical knowledge. The club is getting together a fine electrical library, and hopes ultimately to secure a club house of its own.

WATER WHEEL PLANT OF 4660 H. P. AT PLATTSBURGH, N. Y.

MANY of our readers will be especially interested in the illustration herewith presented of the turbine water wheel plant furnished by The Stilwell-Bierce & Smith-Vaile Co. of Dayton, Ohio, for driving the new Pulp Mill of the Freydenburgh Falls Pulp Co., Plattsburgh, N. Y. The plant consists of eight 33 inch, one 30 inch, and one 15 inch cylinder gate Victor turbines all on horizontal shafts and all supplied from one feeder 18 feet diameter at its large end. The photograph was taken in the water wheel erecting shop where the work was set up complete before shipment. Any large development of water power is particularly interesting at this time when the attention of so many is devoted to water power in connection with electrical developments.



THE 4660 H. P. WATER WHEEL PLANT FOR PLATTSBURGH, N. Y.

WESTERN NOTES.

THE GENERAL ENGINEERING COMPANY, T. A. Colby, president, S. A. Stevenson, secretary, have been appointed sole agents for the State of Iowa for the Boudreaux Dynamo Brush Co.

MR. G. W. CONOVER, Western Manager for the Perkins Switch Mfg. Co., is back from a week's trip to St. Louis and other places, where he succeeded in booking several nice orders.

THE CHAS. E. GREGORY Co., Chicago, have just issued a new edition of their bargain list which as usual is full of interesting information to all in need of anything electrical.

MR. H. M. UNDERWOOD for many years identified with the electrical business in the introduction of new devices in the West, e. g., Interior Conduit, The Strowger Automatic Telephone Exchange, etc., has recently been appointed General Sales Agent for the Belding Electric Alarm Mail Box Company, Chicago, and will no doubt prove a valuable exponent of this meritorious device.

MR. FELIX T. MEYSENBURG, of Kroell & Meysenburg, St. Louis, spent several days in Chicago last week placing orders for material and apparatus for some of the plants they have under construction.

MR. W. F. PARISH, General Sales Manager for the Racine Hardware Company, has moved to more commodious quarters in the Marquette Building, Chicago. Mr. Parish reports a steady increase in the sales of the Racine automatic engines.

MR. EDWARD R. GRIER, of the firm of Grier Bros., Western representatives of Bryant Electric Co., was married to Miss Lucy Parthenia Bosworth, of Lee, Mass., on April 16th, 1895. After a short trip Mr. and Mrs. Grier will return to Chicago.

COUCH & HEYLE, of Peoria, Ill., have let the contract, and work has commenced on a new factory for the use of the Diamond Electric Co. The new building will cover a space of 50 x 170 feet and be five stories in height.

LANCASTER, OHIO.—The lighting plant at the State Industrial School for boys has been completed. The contract covered the erection of building, steam plant, and both arc and incandescent lighting and was secured by the Franklin Co. of Kansas City, Mo.

MOLINE, ILL.—The People's Power Co. are installing a large new generator made by the Stanley Co. of Pittsfield, Mass. They are also putting in a new 700 H. P. cross compound condensing engine. This will give them a total capacity of 2,000 H. P., and the ability to furnish 10,000 incandescent lights.

W. R. SUMMERHAYES, Vice President and General Manager of the Mutual Electric Light Company, San Francisco, Cal., was among the Chicago visitors recently. Mr. Summerhayes' company is installing a modern lighting plant in San Francisco which they expect to have in operation within a short time.

THE METROPOLITAN ELECTRIC COMPANY will soon publish a new edition of their general catalogue, which promises to be one of the most complete publications of its kind. Among their latest important specialties may be mentioned their new carbon battery which has several new features, and is made by entirely new methods.

THE COLUMBIA INCANDESCENT LAMP CO. through their Chicago Agent, Mr. J. M. Hill, have secured the contract for furnishing the lamps for the new Steinway Music Hall, which will be opened on May 1st. The awarding of this contract is of especial interest as it is the first instance in that city where the architects' specifications were extended to the incandescent lamps. The specifications called for lamps of 20 and 16 C. P. Lamps of 20 C. P. to have an efficiency of 62½ watts per lamp and the 16 C. P. lamps to take 50 watts. Guarantees as to maintenance of candle power after 800 hours run, as well as to length of life, were asked for. Samples of lamps furnished were subjected to photometric and efficiency tests before considering bids. The Columbia Incandescent Lamp Company are to be congratulated on securing this important contract. They were the highest bidders.

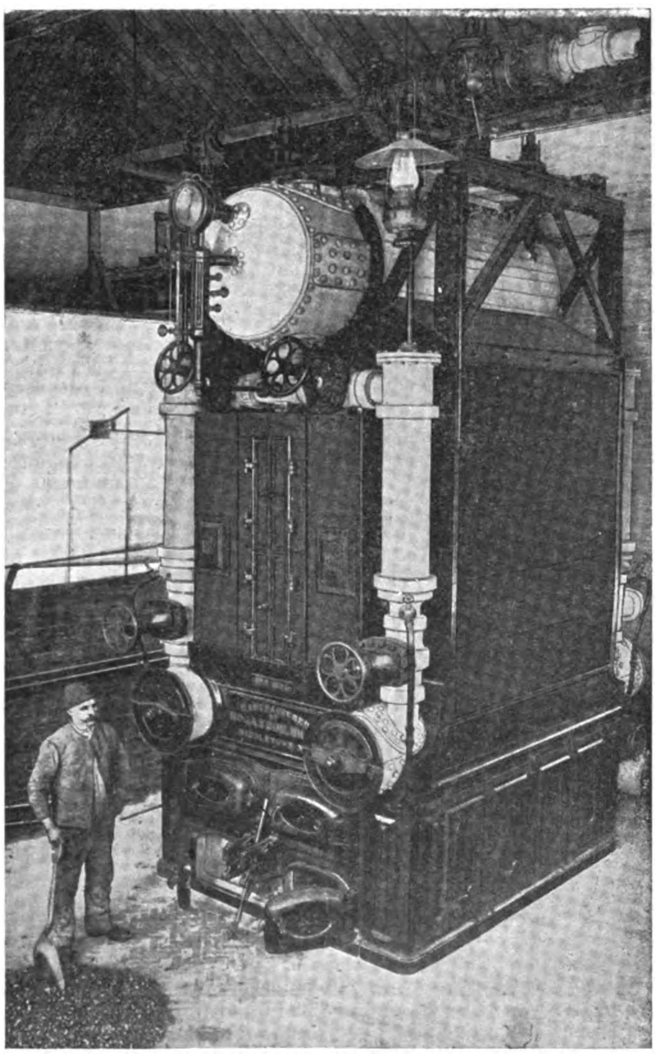
THE HOGAN VERTICAL WATER TUBE BOILER.

At the invitation of the Hogan Boiler Company a representative number of gentlemen gathered at the works of the company at Middletown, N. Y., on April 11, to witness a test of the Hogan boiler.

The appearance of the boiler is well shown in the accompanying engraving Fig. 1, and Fig. 2 shows it in section.

As will be seen the boiler consists of a horizontal steam drum connected by 2-inch boiler tubes with vertical manifolds. The manifolds are in two rows, one on each side of the combustion chamber. The tubes are expanded in the usual way into the manifolds and the steam drum, the joints being so placed that the direct action of the heat of the fire does not affect them. The tubes constitute all the heat absorbing surfaces of the boiler, and are the only parts exposed to the fire, and they are placed directly over the grate. The front end of the distributing and steam drums are connected by 6 and 10 inch pipe. In the latter are placed the feed-water heaters. The back ends of the distributing drums are connected to the circulating drums, the lower part of the back end to the mud drum. The mud drum is placed outside of the back wall of the furnace, wholly removed from the flues and heated gases. The upper sides and also the tops of the circulating drums are connected to the lower end of the steam drum.

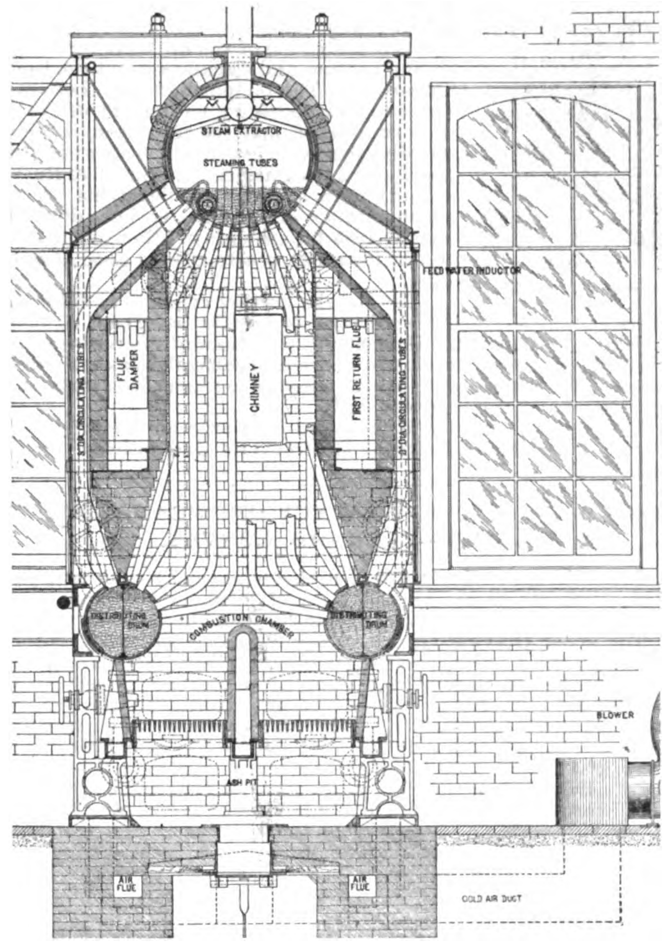
The circulation of the water will be observed to take the following course: In the feed-water inductor, the cold water passes down and up, absorbing heat from the descending current from the steam drum and becoming a part of this current on passing through a series of perforations near the top of the 10-inch pipe which connects the steam and distributing drum. The descending currents pass through the circulating drum to the distributing



THE HOGAN VERTICAL WATER TUBE BOILER.

drum; the latter receiving the impurities of the water and discharging them into the mud drum. The ascending currents pass from the distributing drum to the manifolds, thence through the 2-inch steaming tubes to the steam drum. These tubes are insulated from the heat of the furnace and their use entirely prevents the mixing of the water with the steam as it is produced.

The steaming tubes exposed to the greatest heat of the furnace are extended into the steam drum, and discharge their contents entirely above the water level. It follows, therefore, that the water to supply the circulation must come from the bottom of the steam drum, and consequently the current must always be in one direction. The tubes receiving less heat are submerged in



THE HOGAN VERTICAL WATER TUBE BOILER.—VERTICAL SECTION.

the water of the steam drum and are denominated water-heating tubes. The tubes entirely removed from the heat are connected to the lower sides of the steam drum and from the path for the descending discharge into the circulating drums. In the steam drum the splashing of water by active circulation from the steaming tubes into the steam space is prevented by a perforated plate placed above the tube openings. Dry steam is thus constantly produced and without the necessity of superheating.

The tests at the works were carried out by a committee consisting of M. N. Forney, Paul Grimm, M. E., and John Hopson. Pending the tabulation of their report we may cite the results of an elaborate series of tests made on a Hogan boiler of 350 H. P. installed last June at the State Homœopathic Asylum at Middletown, N. Y. These tests were carried out by Prof. R. C. Carpenter and W. R. Eckert, Jr., of Cornell University and gave the following excellent results in evaporation: With anthracite pea coal, 12.65 lbs. of water per pound of combustible; soft coal, 12.2 lbs. of water; and with steam coal, 13.68 lbs. of water. In these tests the percentage of moisture did not exceed 1.75 %.

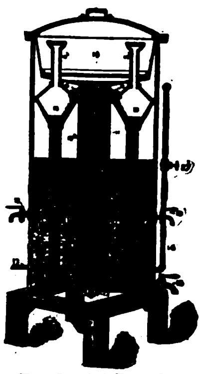
The visitors were shown over the well equipped works, which are busy on a number of large contracts recently closed.

SUPPLIES WANTED.

Purchases for the 450 arc light plant for Hudson County, N. J., and for the 150 arc and 2,000 incandescent light plant for Kearney Township, Hudson County, N. J., will be made at the office of Geo. F. Woolston, Jr., 40 Wall street, N. Y.

KROELL & MEYSENBURG, St. Louis, were the successful bidders who secured the contract for the Webb City, Mo. municipal plant. The plant will consist of 80 arcs and 1000 incandescents, and Kroell & Meysenburg intend to make it a model plant in every respect. There were 26 bidders.

THE EUREKA DOUBLE-ACTING WASTE OIL CLEANSER AND PURIFIER.



Eureka Oil Purifier.

The prudent station manager avails himself of every device looking to economy, and seeks, wherever possible, to reduce the operating expenses. Much may be done to economize in fuel cost but there are many other minor opportunities, among which the full utilization of the oil used for lubricating engines and dynamos is not the least important. The oil purifier has therefore come to be a necessary equipment of every well-run-station and the accompanying engraving shows the waste oil purifier built by the Eureka Oil Purifier Co., (Schall & Rutherford), Betz Building, Philadelphia. This purifier takes oil, no matter how dirty or mixed with filings, chip or other impurities, and turns it out practically as good as new oil.

The Eureka purifier contains no filtering material, the oil being subjected to gentle heat, causing it to limber up and drop its sediment to the bottom of the refuse well, after which it causes the oil to be washed perfectly clean through water. The refuse well can be cleaned without disturbing the purified oil and water in the tank.

The Eureka purifier is installed in a large number of establishments including numerous electric light and railway power stations.

LONG LIFE AND EFFICIENCY OF INCANDESCENT LAMPS—PACKARD CURVES.

LONG life and efficiency will probably always remain antagonistic elements in the present type of incandescent lamp, and hence the voltmeter will bear as careful watching as ever.

The accompanying curves, plotted from a series of measurements on the regular make of 16 C. P., 3.1 watt Packard lamps will warrant, therefore, a little study from any one interested in electric lighting, as they constitute an excellent argument for good regulation of E. M. F. Take, for example, the curve of efficiency, Fig. 2; a regular 3.1 watt lamp at 10 C. P. burns at 4 watts, and at 20 C. P. at 2.5 watts. Now, as seen from the curve, Fig. 1, this represents a range of only 11 volts in E. M. F. In other words a 10 per cent. regulation in circuit means that at one minute a lamp may be burning at 4 watts and the next minute at 2.5 watts, and it is undoubtedly this jumping from one efficiency to a higher one that proves so disastrous to lamps, for if there is a weak spot anywhere in the lamp this jumping rapidly develops it.

To one interested in high efficiency lamps the curves also show that with a well made 16 C. P. lamp any desired efficiency can be obtained, and if one is desirous of trying a 2.5 watt lamp, all that is necessary is to take a 3 watt 16 C. P. lamp and run it at 20 C. P.; or a 4 watt 10 C. P. lamp burned 10 or 11 volts high would give the same result. A little experimenting of this kind will convince any one that the natural efficiency of the present incandescent lamp is between 3 and 4 watts, and a lamp burned over 3 watts efficiency has too short a life to figure as a commercial success.

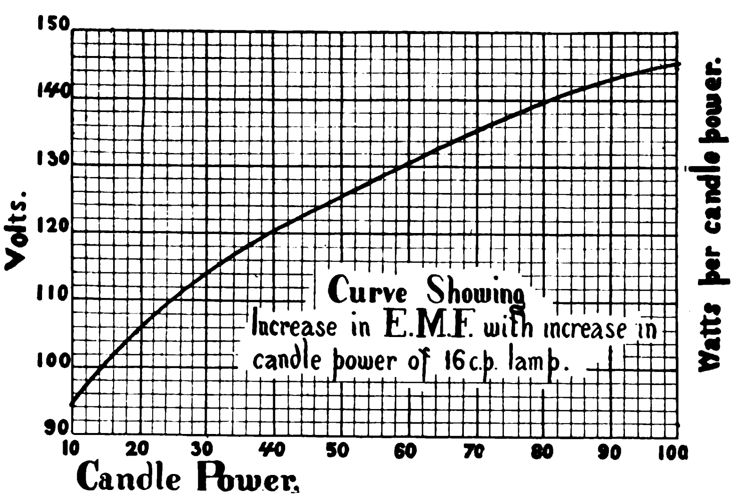


FIG. 1.

The critical portion of the curves may be said to be from 10 to 20 C. P., for here a small variation in E. M. F. means a great variation in efficiency, but above 20 C. P. the curves, as shown by their flattening, show only a very small variation in efficiency for a marked variation in E. M. F. In making tests of this kind it is necessary to watch the lamps closely in order to make sure that they do not adapt themselves to the circuit; that is, that they do not drop in candle power at once, so as to come down below 3 wtats efficiency, for it is well known that a great many lamps show this trait to a very marked degree, and this probably explains the long life claimed for some of the high efficiency lamps.

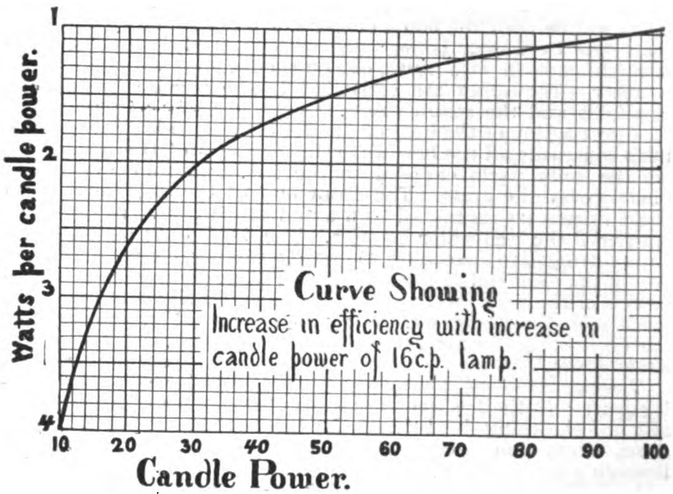


FIG. 2.

NEW YORK NOTES.

EDISON BUSINESS LARGER.—The New York Edison Co. shows in its March earnings a total of $130,407 or a gain of $17,801 over the same month in 1894.

MR. CHARLES HOLMES, the purchasing agent of the Chicago Edison Co. was in town last week, his trip this time including also the East. He reports business in Chicago as quiet but considerably on the mend.

THE STANLEY ELEC. MFG. CO., of Pittsfield, Mass., were represented in New York last week by their general manager, Mr. Henry Hine, and electrical engineer, Mr. J. F. Kelly. They report the outlook for their two phase work as brilliant, and are very busy.

MR. R. L. WEITHAS who has been on the business staff of *The Electrical World* for five years past has, we are requested to note, resigned and will henceforth act as secretary and manager of Burrelles Press Clipping Bureau, at 195 Broadway, N. Y. Mr. Weithas has our best wishes for his welfare.

J. H. BUNNELL & CO., at the busy Cortlandt street portal of New York, are in touch with the reviving activities of the Spring season. Their large store is a thronging centre of trade, and hardly a line of goods is without inquirers and purchasers. Being free now from the uncertainties attending some of the earlier telephonic apparatus they took up, they are in the market with a line of instruments which they describe as entirely free from possible legal complications and free also from practical defects. It is meeting with a brisk demand. In fan motors, the firm also report a rush, and both Messrs. Bunnell and McLaughlin watch the thermometer go up with expressions of complacency that must be seen to be appreciated.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY is again out after the lightning arrester business with the "Swinging Ball Lightning Arrester" which has made such an excellent record during the past five years. Prices have been very much reduced and a large business is looked for during the present season.

TERRE HAUTE, IND.—Prof. Thos. Gray and Mr. C. Leo Mees have made a report on the proposed municipal lighting plant. It is of Western Electric make. They found it in excellent condition, well built, and giving service much above the requirements. The plant is in the hands of the Citizens' Electric Lighting Company.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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THE COX THERMO-ELECTRIC GENERATOR FOR THE CONVERSION OF HEAT DIRECTLY INTO ELECTRICAL ENERGY.

BY

Harry Barringer Cox

THE thermo-electric principle involving the direct conversion of heat into electrical energy was first discovered by Professor Seebeck, of Berlin, in 1821. Following Seebeck's discovery and for years thereafter, the subject commanded the earnest attention of experimenters, but as year after year passed and no pronounced progress was made, the subject came to be considered the electrical ignus fatuus; and thermo-electricity as a commercial possibility was relegated to the scientific scrap-heap. The trouble was not that electrical energy could not be produced by the direct conversion of heat, but rather that the high cost of direct conversion, the instability of the apparatus, and its low efficiency, made it commercially prohibitive.

It must be borne in mind that low efficiency and high fuel cost were not by any means the principal drawbacks, as is generally supposed,—the fatal defect was *lack of stability*. To first produce a generator which could transform heat energy into electrical energy in a practical way and produce that same energy *continuously* was the first requisite. Deterioration in a practical apparatus should not be in excess of ordinary converters of energy. Deterioration must, of necessity, take place in any apparatus constantly subjected to heat, but if that deterioration is reckoned in years instead of days it is no practical detriment.

After a generator has been produced which will or can generate an electric current direct from fuel and whose rate of deterioration is not excessive, then the first cost should be considered. On the other hand a direct conversion should at least compete in cost with the apparatus it proposes to supplant or compete with. When prohibitive deterioration and excessive first cost are over-

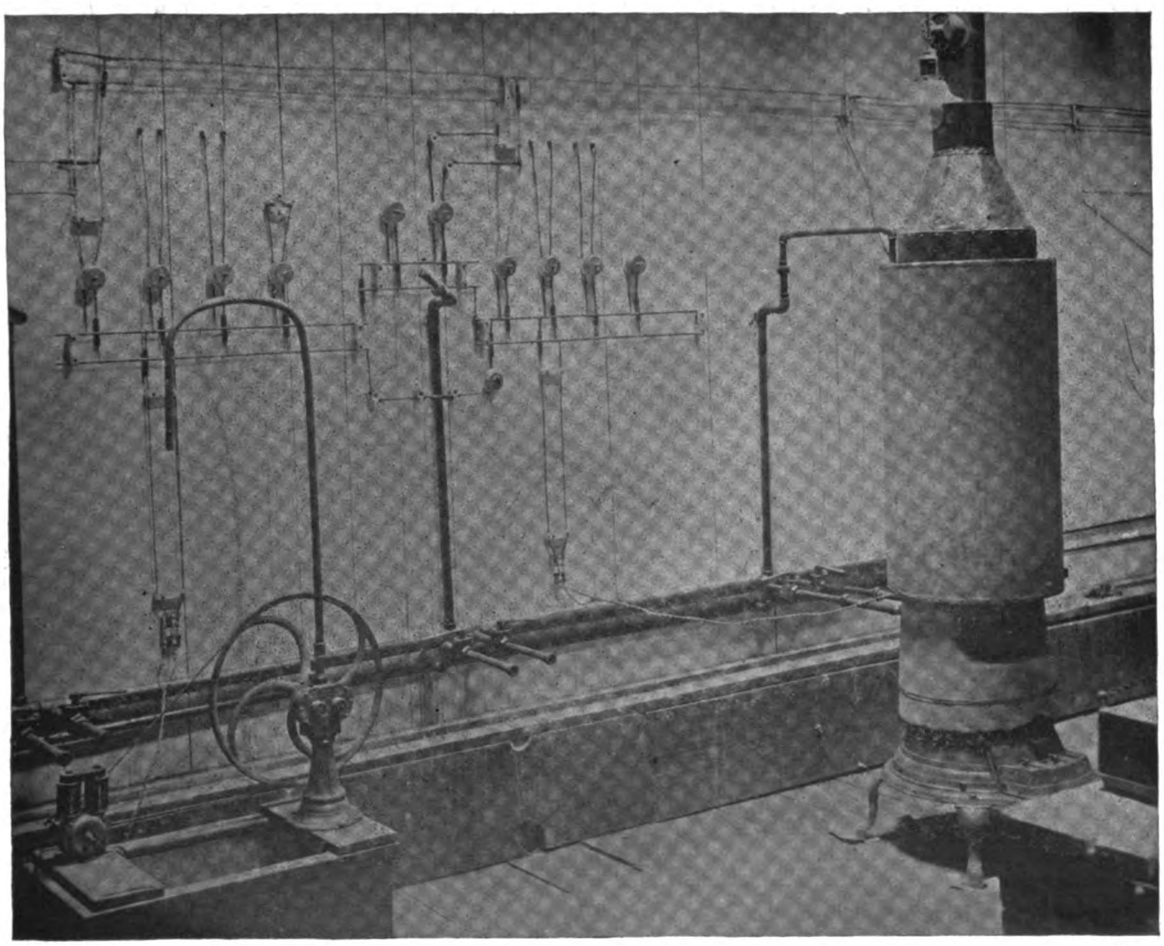


FIG. 8.—COX 110-VOLT THERMO-ELECTRIC GENERATOR, OPERATING LIGHTS, MOTOR AND PUMP, ETC.

come, then, and not until then, is it necessary to consider fuel expense.

The present practice of producing electrical energy from fuel is first to generate steam in a steam-boiler, transmitting this steam to the steam engine, the engine producing mechanical movement, transmitting this mechanical movement to a dynamo, and the dynamo generating electrical energy. That 90 per cent. of the initial energy is lost in ordinary steam conversion will be conceded; and 95 per cent. would be close to the average in ordinary central stations. In small steam plants as high even as 99 per cent. is lost, so that it is evident that a direct converter of heat into electrical energy has a promising field for competition. In justice to the electrical end of steam conversion it should be stated, however, that were the steam boiler and engine as efficient in conversion as is the dynamo, a direct converter would have but a small field of usefulness.

The attempt of most thermo-electric workers has been to produce a generator of high voltage, to the apparent complete disregard of the ampere output, which is a natural result if one be conversant with the statements made by most writers, and by all text-books, namely, that the chief trouble with thermo-electric generators is their extremely low voltage. That they produce but a small ampere output was tacitly accepted and apparently not disputed or questioned. The value of an electric generator or converter, however, is not to be judged by the voltage alone, but also by the ampere output. In other words, it is not a question of how many volts can be produced, but of how many watt-hours or foot pounds of energy can be transformed per pound of coal, or per cubic foot of gas.

To recapitulate, the various successes and failures of former experimenters would apparently place thermo-electricity about where Seebeck left it. Improvements in form and kind of couple have been made—improvements in heating, and improvements in the general arrangements of the several parts. Time, money, and ability have been spent in trying to increase the voltage of the couple and in attempts to improve the general arrangement.

The writer's investigation of the results actually accomplished, early indicated to him that before thermo-electric generators could become even a successful piece of laboratory apparatus, let alone a commercial device, oxidation of the junction, disintegration of the couples and the gradual but fatal deterioration of the entire element must be overcome.

In the apparatus to be described, the defects in former thermo-generators have been entirely eliminated. Oxidation, disintegration and general deterioration do not take place. A practical, commercial direct converter is produced which can be successfully operated by any one.

Oxidation of the junction was pointed out as a serious defect. In the generator devised by the writer, that is overcome by having practically no real junction point, for what would be a junction point is now so formed as to produce what is termed a graduated alloy; that is, the two alloys composing the element are graduated or shaded one into the other, so that there is no real point of junction. Disintegration in the old types of thermo elements is due to a partial or complete break in the couples composing the element, the result of which is either a complete break in the circuit or the interposing of internal resistance to such an extent as to make the ampere output a mere trifle. Some of the causes of disintegration were: defective and improper metals or alloys used; defective and improper casting; case-hardening; unequal strain and lack of homogeneity of crystal; also improper application of heat or failure to allow for contraction and expansion.

In manufacturing the couples used in the writer's generator, special care was used in the production of alloys which should be electrically efficient and reasonable in cost. It was found that no two dissimilar metals could be simply joined together and stand the peculiarly trying strain to which thermo couples are subjected. A graduated alloy junction then suggested itself; that is, a shading of one alloy into the other and dispensing with any real junction point. This theoretically would accomplish the result.

The couples used in this generator are made with a fused and graduated junction formed between two alloys in which the fusion point of the molten alloy is actually over one thousand (1,000) degrees of temperature less than that of the cross-connection, or solid alloy, to which it is joined. While this may appear to be a mechanical impossibility it is commercially and practically done and produces a so-called junction in which oxidation is absolutely impossible, as the alloys are so fused and graduated one into the other that there is no actual point of junction. These couples after manufacture may be used in the construction of the active element of a generator of any size, say, from one consuming a foot of gas per hour to a large coal burning apparatus.

To prevent oxidation of the metals used, either by the atmosphere or by the products of combustion, the completed element is entirely encased in a cement which is afterwards vitrified. This preserves the element from oxidation and it also changes it into a hard stone cylinder, free from possible breakage or derangement of parts. The accompanying engraving, Fig. 1, shows the construction of the element and Fig. 2 the same grouped circularly with the interior cemented and giving some idea of its compactness. Fig. 3 shows a vitrified element without metal jacket.

To explain the practical manufacture of these generators in brief: First the couples are cast in any desired number. This casting is done in special moulds which form and then free the completed casting in a few moments, no soldering or brazing being employed in the operation. A sufficient number of the couples are then taken to produce the watt energy required, the size and shape of the couple governing the volt and ampere output. After the couples have been selected to conform with the output desired they are then subjected to a resistance test.

The necessity of some absolute, standard method of testing the castings before being used, besides a mere superficial examination, was early recognized. The bridge test was adopted as being the most positive, for it was found that a defect in a casting could always be detected by its internal resistance. A standard resistance was established by making a large number of castings, taking the absolute resistance of each, then setting aside the castings whose resistance indicated apparent perfection. The higher resistance or defective castings were then carefully tested and finally dissected, until the cause of the increased resistance was found; then the apparently perfect castings were carefully broken up and found to be without flaw. The average resistance of these perfect castings was taken, and established as a standard. All castings now used must conform to that standard.

The element is formed of successive rings of these castings, and all parts are thoroughly insulated. Terminal wires are then brazed to the pole pieces and the entire element clamped in position before removal from the form. A second resistance test is then taken to detect any error in construction.

The interior is then lined with plastic cement. This cement is of such a character as to adhere, when properly applied, very closely to the metal parts, and when dry and vitrified to have practically the same characteristics as the metal element in so far as contraction or expansion is concerned. It becomes in fact an integral part of the element. Although subjected to direct heating, it shows no signs of deterioration, even in machines which have been subjected to heat for three years or more. After this internal cementing has been done, it is then dried and finally vitrified. The element is then allowed to cool and a third resistance test is made.

Following this third test the element is entirely encased in cement and again dried and vitrified. When cool a

fourth resistance test is made, and if the element is still perfect after passing this test, a metallic jacket is closely cemented to the exterior of the element. This jacket, after being vitrified and its edges joined, forms the outer wall of the element and afterwards becomes the inner wall of the water back employed. This metallic jacket was finally selected as the protecting and insulating back for the element after various kinds of paint, varnish, gutta percha, rubber, glazes, soluble glass and other materials had been tried. This jacket, which is usually light copper well annealed, is intimately connected to the outer wall of the element, but perfectly insulated therefrom electrically.

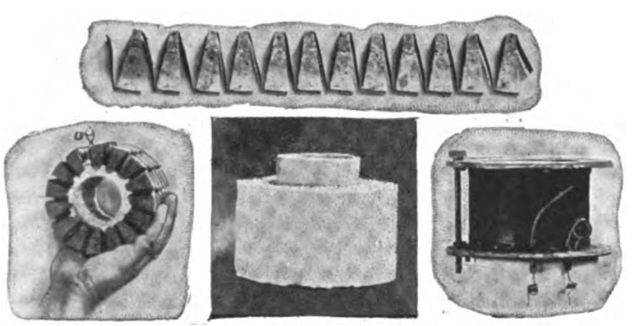
End pieces are then joined to the projecting ends of this metal jacket by soldering or brazing in such a manner as to produce water-tight joints. The terminal wires are carefully insulated and led out to proper binding posts or other connections. Fig. 4 shows a completed gas burning generator with the outside jacket of the water back removed; it also shows the terminal wire and inlet and overflow water pipes.

When the generator is complete it is given a final resistance test, then connected with a proper water and gas supply and submitted to a twenty-four hour active test. During this test its electrical output is carefully noted to detect any change from normal. It is then allowed to cool and its resistance again taken.

The water backing to the machine is maintained either by a small supply of running water or by a radiating supply tank. The water back is required to be constantly full, but the temperature of the water may be anything, from normal to a temperature as high as 150 degrees, without detriment to the apparatus or any material reduction of current output.

The engraving Fig. 5 illustrates the element shown in Fig. 2 completed with bracket and gas burner. In the interior of the generator and supported from the top is a series of deflectors, small at the bottom and gradually increasing in size towards the top, so that the distribution of heat is even throughout. These deflectors are of iron, and, becoming red hot, they burn all offensive products of combustion so that no odor is detected. These deflectors by breaking up the heat column, produce diffusion as well as deflection, and while a simple device, have proved very effective in heat conservation.

The average gas consumption of this generator is $2\frac{1}{2}$ feet per hour. Varying terminal outputs may be had from machines of this type, size, and gas consumption. For instance, machines are produced giving $\frac{1}{2}$ volt and 90



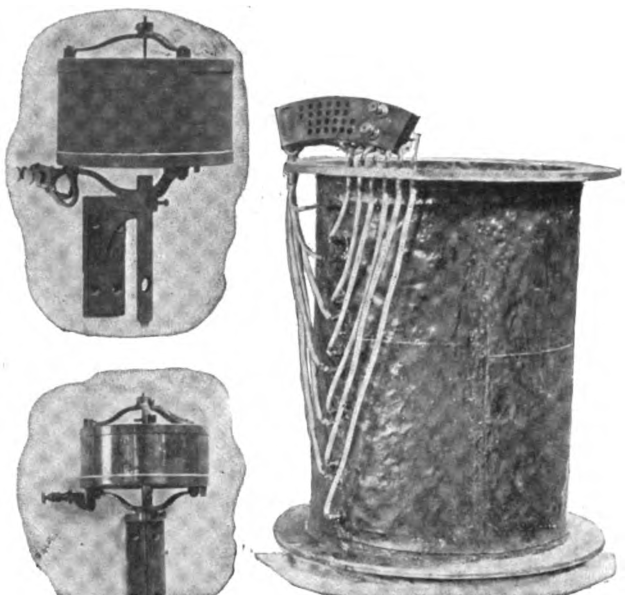
FIGS. 1, 2, 3 and 4.—DETAILS OF CONSTRUCTION OF COX THERMO-ELECTRIC GENERATOR.

amperes; 1 volt and 45 amperes; 5 volts and 9 amperes; 2 volts and 22 amperes; 11 volts and 4 amperes.

Fig. 6 shows a small gas machine with total gas consumption of $1\frac{1}{2}$ feet per hour. The height of the active element is $1\frac{3}{4}$ inches; inside diameter, 1 inch; outside diameter, 4 inches. Its terminal output is 5 volts and 5.5 amperes; weight of complete element, 3 pounds.

It may be mentioned here that with a total gas expenditure of about 7 feet per hour, the New York office of the Commercial Cable Company operated its entire lines for several weeks with these generators. The Company accounted the saving at that station as 8 to 1 in favor of the generator over its present system. As a result of the test the Company's entire system will be equipped with these thermo-generators.

Fig. 7 shows a 55 volt 5 ampere coal burning generator



FIGS. 5 AND 6.—TYPES OF COX GAS BURNING THERMO GENERATORS.

FIG. 7.—COX COAL BURNING THERMO GENERATOR, WITH WATER BACK REMOVED.

with its outer jacket removed; height, 18 inches; diameter, 15 inches. This machine, even with coal at $4.50 per ton, generates current at a cost of one-fifth ($\frac{1}{5}$) of a cent per lamp hour.

Fig. 8 is a view of an old and tried coal generator. This generator has been in active use in the writer's laboratory at Hartford, Conn., for about three years, and is still used. By a most careful bridge test the resistance is shown not to have changed in the slightest during that time, and absolutely no repairs have been made upon the generator in any way. It is as perfect in condition as when first used.

The figures and facts above stated show that a direct converter can be built which is practicable, permanent and which shows also a marked economy. While the first object in this work was to construct a machine in which mechanical and electrical defects were eliminated, the necessity for economy in fuel expense was also recognized.

In the experimental work on this apparatus it has been discovered that it required a particular form or kind of heat. So remarkable was the difference in output found to be with various forms and kinds of fuel that the output electrically was increased 300 per cent., by simply using the proper heat, and this increase was made with an actual saving in fuel.

That these machines can successfully and commercially convert heat directly into electrical energy in any desired output is indisputable. That they also, even in small apparatus, show a marked economy must now be conceded.

FLUORESCENCE OF SOLUTIONS.

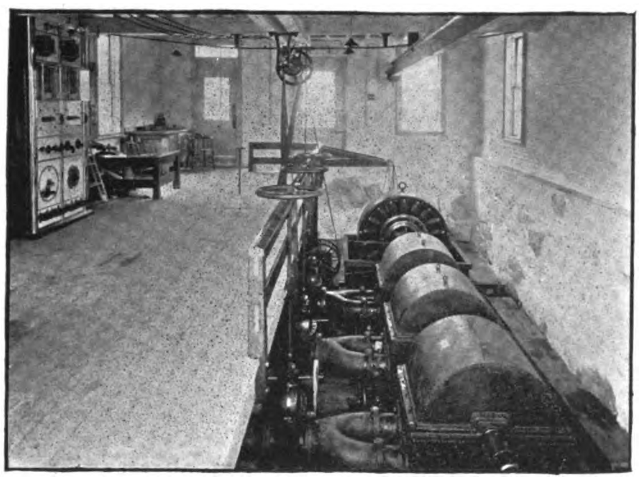
O. Knoblauch in *Wiedemann's Annalen* shows that there is a constant ratio between the intensity of the fluorescence and the existing light, even when the intensity of the latter is altered in the ratio of 1 to 6400. The author proves experimentally and theoretically that the effect upon the various fluorescent bodies of varying the solvent is very different.

A 300 K. W. TWO-PHASE INSTALLATION AT FITCHBURG, MASS.

BY H. M. FLOY.

Owing to the frequency with which polyphase apparatus is now being installed in this country the putting in operation of a new plant creates hardly a passing comment unless the apparatus includes some novel or peculiar features. In some ways the plant at Fitchburg, Mass. just installed by the Westinghouse Electric & Mfg. Co., for the Wanoosnoc Power Company is peculiar and therefore interesting.

The generating station consists of a small power house, 40 x 25 feet in area and 20 feet in height, situated on the Wanoosnoc River about three miles from the city of Fitchburg. In this building, illustrated in the accompanying engraving, there is installed one 300 K. W. Westinghouse two-phase generator, of the "plus two" type; that is, it has two more teeth on the armature than there are poles in the field. This machine has eighteen laminated pole pieces, projecting inwardly from a cast iron yoke. The armature is of the Westinghouse regulation toothed



WESTINGHOUSE 300 K. W. TWO-PHASE PLANT, FITCHBURG, MASS.

type, wound with machine-made coils, thoroughly insulated. In fact, all features of the generator are those regularly employed by the Westinghouse Company in their standard machines. The current is generated at a potential of 2250 volts and handled at this pressure at the switchboard whence it is transferred directly to the transmission circuit.

The field current of the generator is supplied from a 15 H. P. latest type, multipolar, Westinghouse exciter, which is of sufficient capacity to excite two 300 K. W. machines, the Wanoosnoc Co. expecting to install a second machine in a short time. The exciter running at 1150 R. P. M. generates current at 110 volts and is driven by a small separate Pelton wheel situated near the large generator, as shown.

The 300 K. W. machine is direct connected to six Pelton double nozzle 28 inch water wheels, all on the same shaft, running at 375 R. P. M. Two wheels are enclosed in each of the three wheel cases which appear in the illustration. Water is supplied from the Wanoosnoc River under a 130 foot head at the rate of 2000 cubic feet per minute, total capacity of the stream. The water is brought 1800 feet from the reservoir to the station through a three foot pipe and at the power house it is received in a four foot main which supplies the feeders to the wheels. The flow of water is controlled by a Doolittle governor which consists of three separately actuated gears, one having large inertia, revolved by a separate water motor and thus kept at constant speed, a second gear, driven by the generator shaft, and between these two is the third gear, connected by means of pinion and rack, with levers that actuate butterfly valves, controlling the admission of the water to the wheels.

The switchboard shown in the engraving is of the Westinghouse standard type, and consists of two panels, one for each circuit, fitted with the following instruments: Two rheostats, one for the field of the alternator, and the other for the exciter. The remaining portion of each panel is in duplicate, there being fuses, switches, voltmeter, ammeter, voltmeter converter, and lamp for each side of the two-phase machine. Back of the board are located two of the Shallenberger wattmeters, the same as those to be used at the Niagara installation, for measuring the total output of the station.

At present, all the power generated is used by the Simonds Manufacturing Company, one of the oldest and finest saw and knife manufacturers in the country. Their works are located 2.15 miles from the power-house. The transmission circuit consists of four stranded conductors, each having a cross section of .4 square inch. The wire is covered with weather-proof insulation, and strung on a special pole line, designed to safely withstand the high voltage used in transmission.

At the Simonds factory the potential is reduced from 2150 to 220 volts by means of two 100 K. W. Westinghouse L. & P. oil transformers. The current is supplied direct at the latter voltage to the following motors: 1 75 H. P.; 4 50 H. P.; 2 30 H. P.; 1 20 H. P.; 1 15 H. P.; 1 10 H. P.; 1 7½ H. P.; all self-starting Tesla motors.

All the above apparatus has been installed and running for about five or six weeks, giving such satisfaction that the Simonds Company have already placed an order for a 225 H. P., high potential ½ phase, non-synchronous, self starting motor, to be operated direct from the transmission line without the intermediate use of transformers.

The perfection to which the Westinghouse people have brought their polyphase apparatus, is evidenced by the fact that it was but little over a month from the time the apparatus was received at Fitchburg until it was installed, operating, and accepted by the Wanoosnoc Company. A part of the credit for such prompt acceptance, however, belongs to Mr. F. H. Davis, the engineer of the Westinghouse Company who installed this plant, who has here certainly made a very creditable record for himself, and to whom our thanks are due for many of the details herein contained.

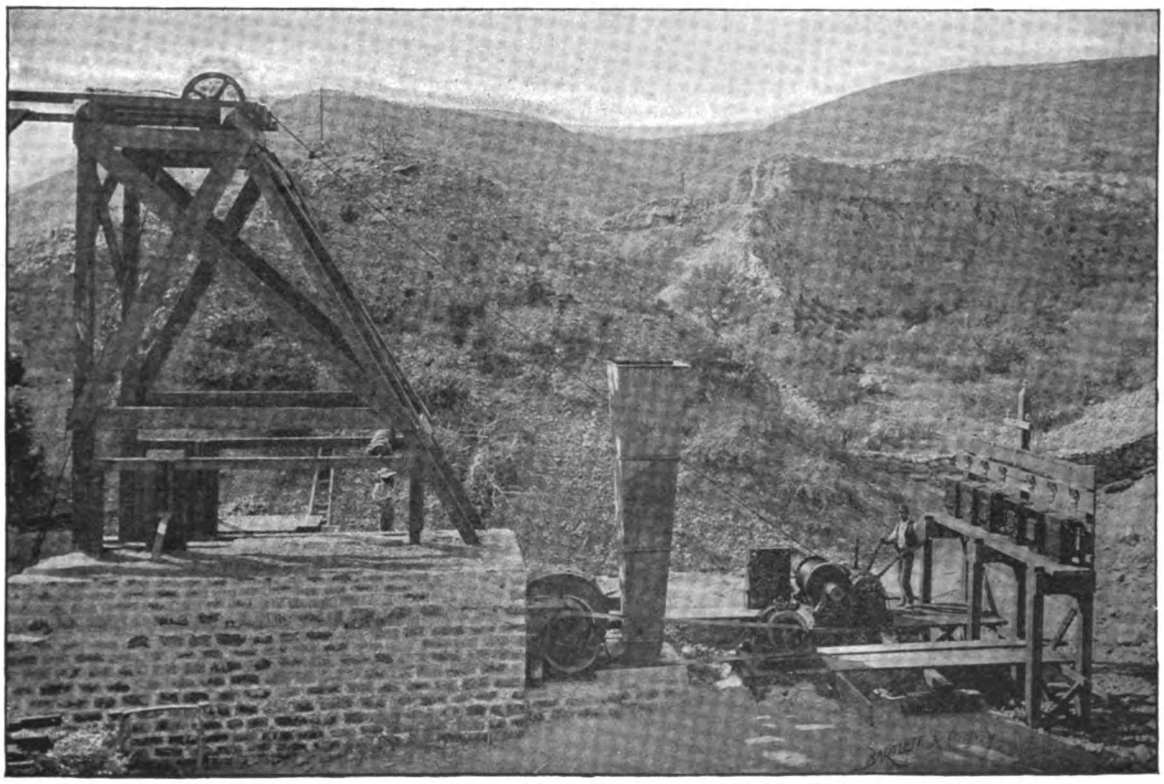
GÜLCHER'S THERMOPILES.

Gülcher's thermopiles, in which an electric current is obtained by simply lighting the gas, have been subjected, says the English *Gas World*, to experimental measurement by C. Brüggemann, Aix, who employed thermopiles which he had been using for two years. The greatest voltage was 3·92 volts, with a current of 2·51 amperes. The voltage was found to vary as the square root of the pressure of the gas used; it was, for pressures between 0 44 and 1·36 inch, equal to 7·3 times the square root of the pressure in inches. But since the outflow of gas is also proportional to the square root of the pressure, it follows that the voltage is directly proportional to the consumption of gas. The highest voltage is attained in about 30 minutes after the gas is lit; nine-tenths of the maximum in about 11 minutes. The internal resistance increases while the thermopile is in use, but soon reaches a maximum, and then remains constant; about 0·912 ohm after two years in one of the piles. At a pressure of 1·2 inch of water, the consumption of gas was 7·8 cubic feet per hour, with a voltage of 3·97 volts.

The Hollerith Electrical System of counting and tabulation, now used so extensively in census work, has been adopted for digesting meteorological reports in the Weather Bureau, under the U. S. Agricultural Department at Washington.

A THREE PHASE PLANT FOR MINING IN THE TROPICS.

Phase work is making rapid development in this country and Canada, as well as Europe, but is still a novelty in the tropics. We illustrate herewith a General Electric three phase plant, which is especially interesting as being the first application south of the United States of the system to mining work. The purchaser owns very valuable and extensive copper mines. Heretofore the numerous pumps, hoists, blowers and machinery scattered over an extended area, have each been operated by small steam engines. Fuel is very expensive, and there is no water power in the neighborhood that can be utilized. After a careful consideration of the problem, electric operation of the mines was selected as most suitable. The steam plant will eventually be concentrated at one station, thus doing away with the many small inefficient engines at scattered points. As the plant is also designed for the highest possible economy the saving in fuel is considerable. The preliminary installation consists of one large three-phase generator feeding directly into the lines at 2500 volts. Ten per cent. loss has been allowed. At four and an a half miles from the generator a 20 horse-power motor drives a blower. At the same place, as shown by the cut, a 15 horse-power motor is direct-geared to a Lidgerwood hoist having a capacity of 1000 pounds at 200 feet per minute. Nine and a half miles in another direction a 20 horse-power motor operates a Knowles horizontal triplex pump. The success of the plant has been assured from the very start. The illustration shows the motors, machinery and transformers unprotected from the elements, as rain is almost unknown in the region.



A THREE PHASE PLANT IN THE TROPICS.—ALL MACHINERY IN OPEN AIR.

MAGNETIC ROTATION OF HYDRO-CARBONS.

In a paper recently read by Dr. W. H. Perkin, F. R. S., before the Chemical Society, he shows that the magnetic rotations of the olefines do not differ from those of the paraffins to quite such a large extent as do other substances correspondingly unsaturated. There are some exceptions, however, which he duly calls attention to. The molecular rotations, speaking generally, which involve both density and specific rotation, exhibit great regularity. Dr. Perkin has been at work upon this subject for years, and has accumulated and published a vast amount of data. Before long, it is anticipated, he will be able to venture some important generalizations of deep import to those who are concerned about the nature of electricity and magnetism.

CAPACITY OF RESISTANCE COILS.

In a recent number of *Comptes Rendus*, M. J. Cauro describes some experiments of his on the electrostatic capacity of resistance coils, wound in several different ways to avoid self induction. He used a Wheatstone's bridge arrangement with a commutator similar to that used by Profs. Ayrton and Perry in their secohmmeter. By comparing coils of practically the same shape and resistance, he found that the errors due to capacity may, in the case of coils containing a large number of turns, be considerable when the ordinary double method of winding is adopted, but these errors are considerably reduced if the method of winding proposed by M. Chaperon is employed. The best results of all are obtained by winding the two wires in alternate layers, always starting from the same end of the bobbin, the wire being brought back parallel to the axis of the coil.

By altering the connection of the two wires in the coil wound in the ordinary manner, so that the current traversed the two circuits in the same direction, the self-induction was found to be 0.13. Thus, by winding the wire double, the error due to electrostatic capacity was about twelve times as great as the error to eliminate which this method of winding was adopted.

AN ELECTRIC RESTAURANT is a proposed feature for the exhibition at Amsterdam, Holland, next year. Guests will be served automatically with a complete dinner on pushing a button. Menier, the great French maker of chocolate has had an actual working plan of this kind at his house, in the shape of little cars running on a circular track on the table.

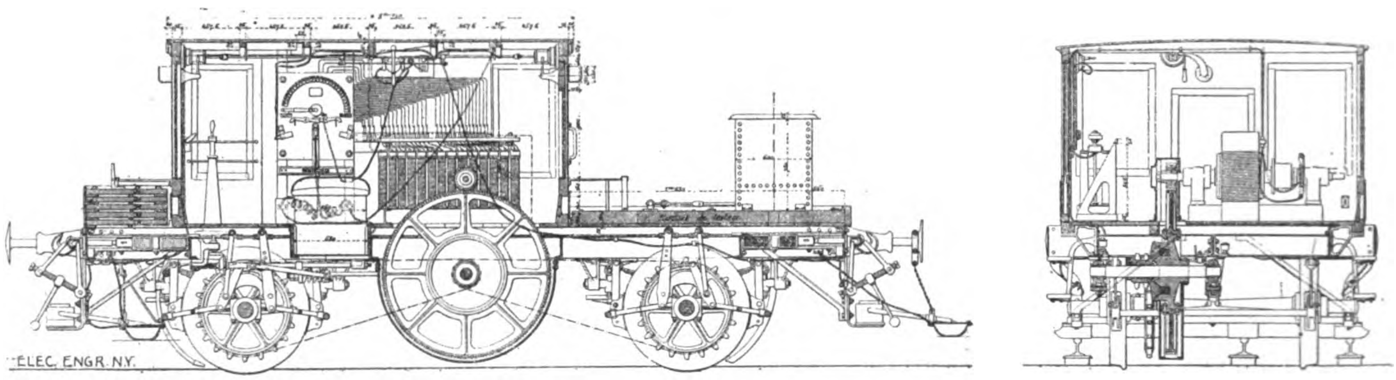
ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC LOCOMOTIVE AT LA BERAUDIERE, FRANCE.

At the Southern extremity of Saint-Étienne, France, and diametrically opposite the principal depot of the City, is the station of Clapier, from which starts a mining railroad, especially constructed for transporting ores from the mines of Montmartre, St. Dominique and Ferrouillat. This mining road embodies (1) a heavy grade of 6.6 per cent., operated by a cable, the loaded cars helping to pull up the empty ones; and (2) a part 1¾ miles in length, which starts from the summit and ends at La Bareaudiere.

Part of the road passes through two tunnels, but movements of the earth in 1893 resulted in a change of the road bed level so that the steam locomotives formerly in use were unable to pass through them. This decided the chief engineer, M. Baudry, to experiment with an electric locomotive, and the accompanying illustrations, Figs. 1 and 2, shown in side and end elevation the design adopted, as communicated by M. Hillairet to the Société Internationale des Electriciens. For this purpose a flat car was taken and loaded down to give it sufficient tractive adhesion. The motor is series wound, and carries a bronze pinion and transmits power to the chain gear through the medium of a magnetic friction pulley, the main current passing through the coil which energizes the pulley. This gives a flexible connection which prevents any undue strain on the chain gear, as the magnetic pulley is arranged so as to slip under abnormal tension.

In front and in the rear of the locomotive are arranged two contact shoes, supported at the ends of levers, which slide on insulated rails. Only one insulated rail is employed, of course, but the engraving Fig. 2, shows three different positions in which this rail may be placed, as the exigencies of the road require. In order to insure a continuity of the rail conductor, copper plates are interposed between the rail and fish plates. The copper plates and the inside of the fish plates are thoroughly cleaned and then bolted up tight. This method of bonding appears to have proved quite satisfactory. The maximum speed calculated for the locomotive is 3.5 miles per hour, on a 1.4 per cent. In actual practice the speed easily exceeds 3¾ miles. On the level the speed is about 5 miles per hour. The section operated by electricity was formerly served by a thirty ton steam locomotive, which was barely able to do the work of the line. Now the electric locomotive, weighing twelve tons, with three tons of ballast, having scarcely one-third of the power of the electric locomotive easily accomplishes the service required, in less time. The fuel consumption is slightly less with the electric locomotive.



FIGS. 1 AND 2.—FRENCH ELECTRIC LOCOMOTIVE WITH MAGNETIC FRICTION CLUTCH AND CHAIN GEAR TRANSMISSION.

ELECTRIC LAUNCH BUILDING AT ASBURY PARK.

The Hickley Launch and Electrical Manufacturing Co., has been organized at Asbury Park, N. J. to manufacture all kinds of launches and also storage batteries. The officers of the company are, A. S. Hickley, president, Claude V. Guerin, secretary and Wistar H. Stokes, treasurer. The Hickley accumulator, which the company will make, employs plates made of filaments of lead wire, giving a large surface together with little weight. The company also makes small incandescent lamps and expects to begin soon the manufacture of large ones up to 500 C. P. Batteries and fans will also be rented to the summer residents during the hot weather.

The company has secured a convenient factory, and, in addition to the steam power, will use the 500 volt street railway current to run motors. Mr. Hickley has now in operation a 16 foot launch with a 6 inch propeller run by a motor weighing less than 50 pounds. With 8 cells of battery the launch makes four miles an hour. With 16 cells the speed is increased to 6 miles. No stuffing-box is employed, but the shaft is encased in a tube whose inner end is above the water line. In this way friction is avoided. Small launches will be rented to the public during the summer.

An illustrated description of Mr. Hickley's earlier experiments with electric launches charged from railway circuits appeared in THE ELECTRICAL ENGINEER of Nov. 29, 1893.

AN ELECTRIC NETWORK FOR NEW JERSEY.

The franchise which was recently granted to the New York and Philadelphia Traction Company was secured as part of a system that will cover about 600 miles of road, which is rapidly under way. It is estimated that the building necessary to comply with the franchise will cost almost $10,000,000. The electric railway will cross the State with its terminal points at New York and Philadelphia.

Beginning at Paterson, the line passes through Upper Montclair and Montclair and skirts the west boundary of East Orange and east boundary of West Orange and the west boundaries of Orange and the village of South Orange. Proceeding southward, it passes through Maplewood-Millburn and Springfield to Westfield, on the New Jersey Central Railroad. Here a line deflects to Rahway, Woodbridge and Perth Amboy, and Elizabeth, and another to the latter place, through Cranford, Roselle and Loraine. This line continues southward from Westfield in the direction of Philadelphia, and passes through Fanwood, Netherwood, Plainfield, and Dunellen to Bound Brook, from which place a branch extends west to Finderne, Somerville, and Raritan, and east through South Bound Brook to New-Brunswick.

From Bound Brook southward in the direction of Philadelphia the main line is laid out through Millstone, Rocky Hill, Kingston, Princeton, and Lawrenceville to Trenton, where it crosses the Delaware River into Pennsylvania and passes through Morrisville, Bristol, Torresdale, Tacony and Holmesburg to Frankford, in the outskirts of Philadelphia. Another branch starting at Trenton follows the Jersey shore through Bordentown, Burlington, Beverly, and other river points to Camden.

The system will connect with every steam road in the State and with almost every electric road between the Hudson River and Cape May. It forms a connection between the Metropolitan Traction Company of New York, the Consolidated Traction Company of Newark and Jersey City, and the Philadelphia Traction Company of Philadelphia.

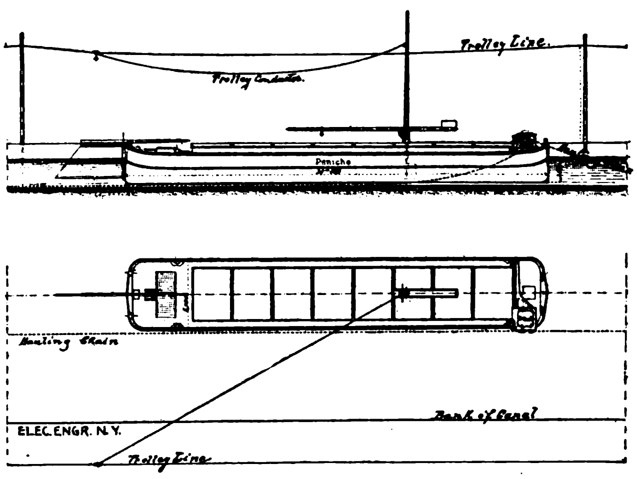
STEAM AND TROLLEY COMPETITION IN NEW JERSEY.

The Consolidated Traction Company, it would appear, is about to enter into direct competition with the railroads for the traffic between the cities and towns of Essex County, N. J., and New York. The lines of the company now completed, and those under construction, tap every nook and corner of the territory, which yields hundreds of thousands of dollars to each of the railroads every year. The fares on the railroads are uniform from competing points. The Consolidated Traction Company will shortly

put on sale tickets good for a round trip from any point on its lines in Essex county to New York and return for 25 cents. This is a cut of about 45 per cent. in the railroad charges. The rate from Newark will remain as at present—20 cents. The suburbs will be most benefited. As the fares now stand, the rate is but 30 cents, and the further cut, it is expected, will draw considerable business from the railroads.

THE DE BOVET SYSTEM OF ELECTRIC CANAL BOAT TRACTION.

REFERENCE has already been made in these columns to the experiments made by M. A. De Bovet in canal boat traction on the French canals, and we are now able to give details of the most recent results obtained as communicated by M. D. Bovet in a paper read before the Société Internationale des Electriciens. The De Bovet principle is characterized: 1. By the employment of a hauling chain and a magnetized pulley and towing mechanism. 2. The permanent utilization of the towing apparatus, which is constantly maintained in service alternately on boats navigating the canal in both directions, thus employing the apparatus to



FIGS. 1 AND 2.—THE DE BOVET SYSTEM OF ELECTRIC CANAL BOAT TOWAGE.

the maximum extent and consequently involving the least possible expenditure. 3. The taking of current from the overhead line by means of a trolley, which is flexible and automatically extensible, so as to remain taut notwithstanding the variations in its length. M. De. Bovet advocates unqualifiedly the employment of two hauling chains, one for travelling in either direction.

The trials took place over a distance of about 1500 feet of the St. Denis Canal, along which a wire ¼ of an inch in diameter has been strung. It was first thought that the part of the chain raised above the surface of the water, owing to the tension

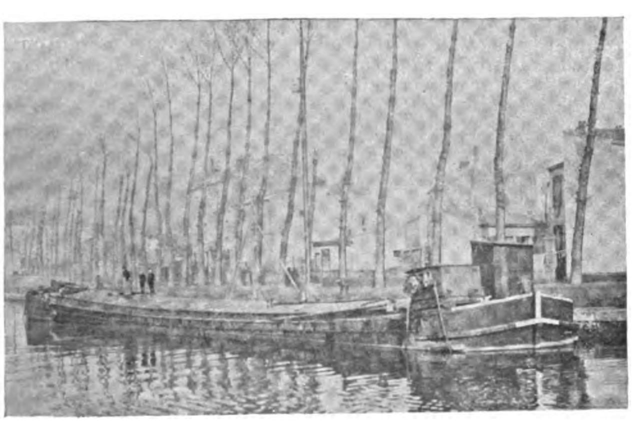


FIG. 4.—CANAL BOAT WITH DE BOVET CHAIN HAULING MOTOR.

between the links, would answer all the purposes of a return conductor in connection with the water of the canal. Experiments, however, proved otherwise, for with a length of 155 feet out of the water the resistance of the chain was so great that the current passing was scarcely able to operate the motor without load; hence it became necessary to install a second conductor on the pole line below the first, which acts as a return conductor.

The accompanying illustrations Figs. 1 and 2 show in elevation and plan the arrangement of the system, supposing, of course, the current to be returned through the medium of the chain. Fig. 3 shows a plan view, in detail, of the motor mounted on the canal boat. The whole towing apparatus is enclosed in a wrought iron case, as shown in perspective in the engraving, Fig. 6. The motor operating at 1,000 revolutions per

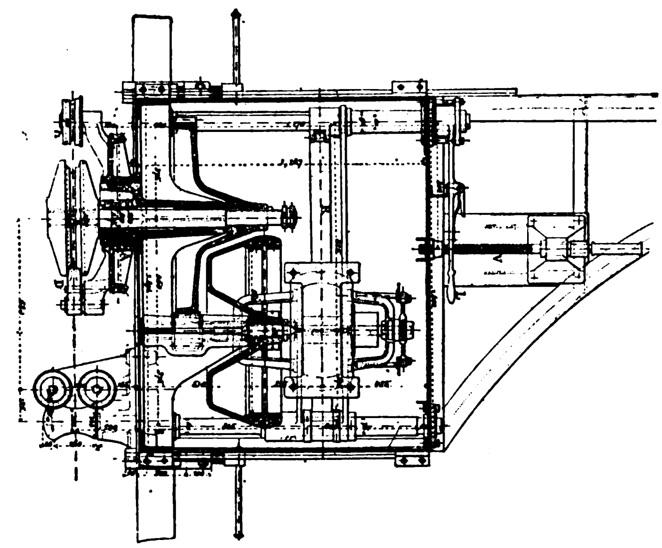
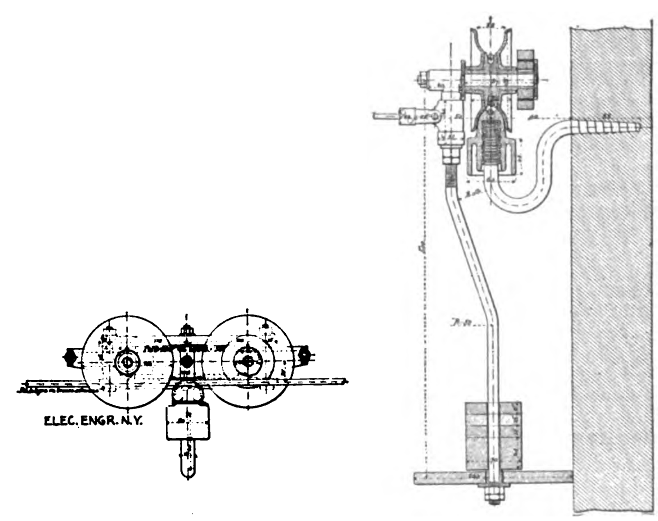


FIG. 3.—THE DE BOVET CHAIN HAULING MOTOR WITH MAGNETIC FRICTION CLUTCH.

minute transmits its movements first through the medium of a magnetic friction pulley and then by means of a gear wheel pinioned to the shaft of the towing pulley, running at forty revolutions per minute, which corresponds to a towing speed of about two miles per hour.

The friction transmission is accomplished by means of a small magnetized pulley mounted on the shaft of the motor, making interior tangential contact with the drum attached to the gear wheels. The motor itself is mounted on a spring, the tension of which can be regulated by a lever projecting through the side



FIGS. 5 AND 6.—DETAILS OF DE BOVET CANAL TROLLEY.

of the enclosing case. By this means an elastic transmission is obtained which is superior to the ordinary method of mechanical friction transmission, the necessary adhesion being furnished by magnetic traction.

Experiments have shown that with the dimensions of the design adopted, a chain weighing about 10 lbs. to the yard, and having 180 degrees contact with the pulley, the towing pulley can carry without slipping a weight of 1100 lbs., with a magnetizing current of two amperes. The tests show that the normal speed of the boat is reached within 88 yards of the starting point, at which point a speed of 1¾ miles per hour is attained with an expenditure of energy equal to 3 electric horse power. The engravings, Figs. 4 and 5, show details of the trolley employed in these experiments.

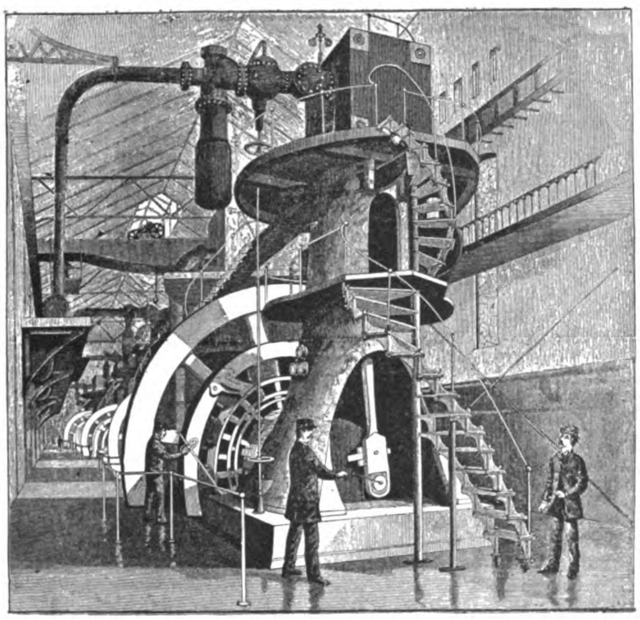
THE POWER HOUSE OF THE METROPOLITAN ELEVATED RAILWAY, CHICAGO.

In our last issue we gave an account of the trial run of a train on the Metropolitan Elevated Railroad, Chicago, which goes into regular operation this week, with map and an illustrated description of the cars employed, which embody some novel points of construction.

The power house for this road is situated on the alley back of Throop St., between Van Buren and Congress Sts. The accompanying engraving, for which we are indebted to the *Scientific American* gives a view of the generating plant.

The generators are of the multipolar type and are direct driven, the armatures being on the main engine shaft. One type of generator driven at 75 revolotions per minute maintains a voltage of 500 on no load and 600 loaded with a current of 2,230 amperes. Another type at 100 revolutions gives 500 volts with no load and 550 volts with full load and a current of 1,450 amperes.

The engines are Allis-Corliss, and are compound inverted vertical, direct acting, standing some 50 feet high with 25 foot flywheels. There are five; two are of 2,500 horse power each, the others of 1,000 horse power each. The dynamo is located between the high and low pressure sides, so as to be inclosed by the engine frames. It is claimed that the energy stored up by the flywheel at full speed is enough to run a train of cars from the power house into the city. A Morgan electric crane of 75 tons



GENERATING PLANT, METROPOLITAN ELEVATED RAILROAD, CHICAGO.

capacity, also shown in the illustration, spans the engine house, commanding the entire area.

Sixteen Babcock & Wilcox boilers with automatic stokers supply steam for the engines. A moving grate carries coal to the fire and delivers ashes from the further end. All the firemen have to do is to keep the coal hopper full of coal. In addition to a 150 foot iron chimney, two huge rotary blowers are used to supply the draught.

"I OBJECT."

The New York and New Haven Railroad Company, by its attorney, has put in objection to ten new trolley schemes in various parts of the state, all being "parallel" enterprises, and, as the company alleges, competing at points where the steam road already fulfills the conditions of public necessity and convenience by supplying passenger trains.

CONNECTICUT TROLLEY PARALLELS.

The railroad committee of the state Legislature has reported unfavorably on the charter for extension of the Bridgeport Trolley Company's system from that city to Milford, thus paralleling the New York, New Haven and Hartford Railroad for that distance. This is another indication that in that committee, and probably in the Legislature, the various trolley parallels will fare badly.

An analysis of the various trolley roads planned in the state shows that they number more than forty, and contemplate trolley lines or extensions with a total of more than 360 miles. Comparatively few of these, however, will seek charters immediately, and some are not yet in the stage where estimates of cost by engineers have been made.

Judge Thayer of the Superior Court has decided in a Hartford case that electric companies under their franchises have the right to remove trees or parts of them on streets when they obstruct their wires. A number of suits involving the question are in the state courts.

ELECTRIC TRACK WELDING TESTS.

The Johnson Company, of Johnstown, Pa., is making tests of a new process of rail welding. Formerly the work of making welds on street rail joints was accomplished from one car, which was burdened with all the machinery required for that kind of work. The company, now, however, has a train of four cars. In one of these is placed a large dynamo which is operated by the current taken from the trolley wire. The second car is known as the welding car, and the third as the grinding car. The fourth contains a storage battery. Formerly the great difficulty in making heavy welds on street roads was in procuring sufficient current. It is thought the storage battery will facilitate matters and serve to aid in doing the work better and with more dispatch.

THE HOLLAND SUBMARINE ELECTRIC BOAT.

The U. S. Navy Department has contracted with the John P. Holland Torpedo Boat Company of New York, for a submarine torpedo boat to cost $150,000. The dimensions of the boat are: Length, 80 ft.; diameter, 11 ft.; displacement, 188-5 tons. The boat is to be completed in every respect by March 26th, 1896. She is to have a speed of not less than 15 knots when in a light condition, 14 knots when awash, with a minimum endurance of 13 hours at these speeds, using only steam power, and eight knots an hour when the vessel is completely submerged, using electric power, with a minimum endurance of 6 hours at this speed. Below 13½ knots for the light condition, or 12½ knots for the wash condition, or 6½ knots when submerged, the secretary of the navy may reject the vessel or accept her at a reduced price.

RECEIVER FOR THE BENTLEY-KNIGHT ELECTRIC RAILWAY CO.

Edward Wells, Jr., has been appointed receiver for the Bentley-Knight Electric Railway Company by Justice Beach, of the N. Y. Supreme Court, on the application of the Attorney-General. It was asserted that the company has been insolvent for a long time, that it formerly had an office at No. 25 Tenth Ave., but has none there now, and that it is practically out of existence, having been absorbed by the Thomson-Houston Company. Frank P. Slade is the president. A judgment was entered against the company January 28, 1889, in favor of the Thomson-Houston Electric Company, for $101,484. Two other small judgments were also entered against it in favor of other creditors. The company was incorporated in September, 1884, and capitalized at $1,000,000.

TROLLEY SPEED INSPECTORS IN BROOKLYN.

Fourteen trolley speed inspectors have been appointed in Brooklyn after a pretty struggle among the aldermen for the spoils. One alderman who "got left" denounced the action as "infamous," which is probably near the truth.

Equally cheering to the trolley companies was a motion also adopted that all the railroad cars be ordered to allow the use of the front platform for the ingress and egress of passengers. The Atlantic Avenue and Ralph Avenue lines wisely refuse to allow the use of the front platform, but, under this new ordinance, they must open the gates for the passengers. Now for more "trolley murders."

LETTERS TO THE EDITOR.

A CURIOUS DROP IN CANDLE POWER.

CAN you afford a little space in your valuable paper for me to get an opinion on a little matter that is puzzling me. I have a ten-pole alternating current generator that is supposed to run at 1,500 rev. per minute, but in the earlier part of the evening (when the engine load is heavy) its speed is about 1,430. The lamps on that machine give a poor light until about ten o'clock (when the engine load lightens) and the generator then makes 1,480 rev. per min. The voltage on the secondary mains is kept steady at 105 volts but there is a marked difference in the light in the latter part of the evening. There is only one volt drop in any part of the circuit. I think the trouble is due to the machine not generating sufficient current for the number of lamps in circuit, until it runs at nearly its proper speed although it is only carrying about half load. I have asked some of my neighboring electricians and they all say if the proper voltage is carried there can be no difference in the light. Will some of my fellow-readers give me their opinion.

J. F. P.

CHICAGO, ILL.

THE FORT WAYNE ELECTRIC CORPORATION'S NEW MULTIPOLAR DYNAMO.

The accompanying illustrations represent a new 60 K. W. medium speed dynamo designed for incandescent lighting and power. It is the first of a series of multipolar dynamos designed by Mr. James J. Wood, the Corporation's electrician and mechanical engineer, which vary in size from 25 to 800 kilowatts. As will be seen in Fig. 1 the design like that of all of Mr. Wood's apparatus presents a graceful and substantial appearance, while the mechanical perfection of detail, workmanship and finish have been equally kept in mind. In the several sizes up to and including 120 kilowatts, the lower portion of the field, pedestals and base are made in a single casting, while in the larger sizes which have an outboard bearing the parts are cast separately and bolted to the base, making the dynamo easier to install, as, should the same design be maintained throughout, the castings would become very heavy and difficult to handle.

A notable feature in this generator is the absence of all loose cables, wires and connections so common on most machines. The connections are made by removing the perforated door where they connect with the main binding posts which are mounted on slate bases at each side, effectively protecting them from dirt or injury. The two small binding posts shown in front are for the field rheostat connections. The dynamo is compound wound and can be run in either direction by simply reversing the brush holders on the studs and without changing any of the other connections, the brush-holders being so proportioned with relation to the commutator that the act of reversing them on the stud changes the point of contact 90 degrees, leaving them in the correct position for commutation when the dynamo is run in the opposite direction. The curved pedestal on the commutator end is also a decided advantage, as it not only reduces the floor space and weight of metal required in the base, but also enables the dynamo to be turned end for end on the sub-base should it be required to belt from either end. The bearings are self-oiling and aligning and are of ample proportion to withstand the strains to which they are subjected, while the field coils are wound on steel spools with brass heads, making them very easy to replace in case of accident.

The armature construction, details of which are shown in Figs. 2 and 3, possesses several novel features, showing in a

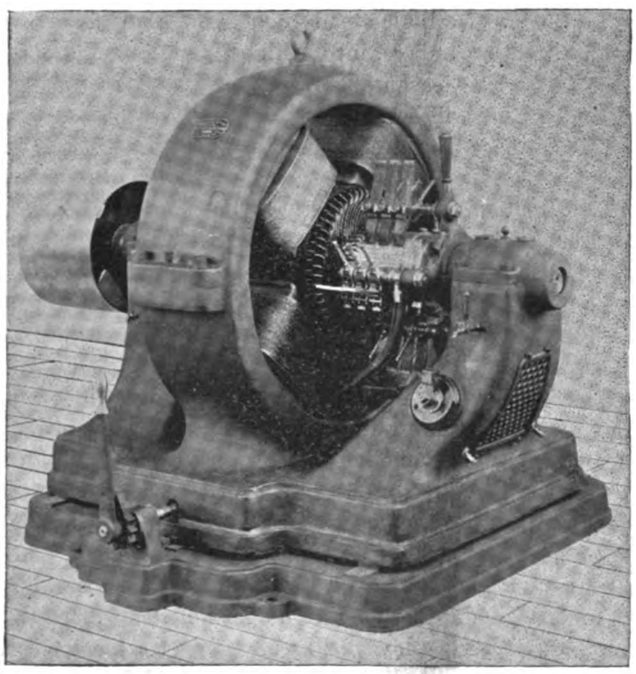
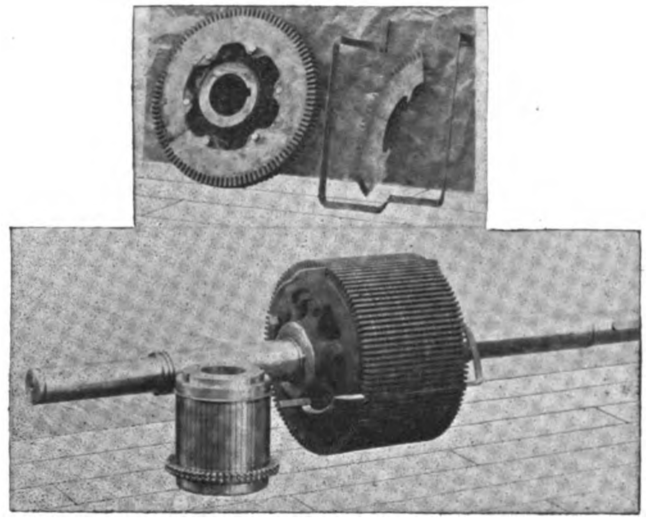


FIG. 1.—NEW WOOD CONTINUOUS CURRENT DYNAMO.

marked degree the ingenuity and originality of the designer. Fig. 2 shows the commutator and core complete with one of the coils in place, while Fig. 3 shows one of the armature punchings, the method of building up the core, and one of the coils before being insulated. As will be seen, the armature core is constructed from segmental punchings, having hooks projecting from the inner edge which partly enclose the clamping bolts. These punchings alternate with one another in order to break joints, the hooks making contact with the bolts on opposite sides, but without completing the magnetic circuit around them. It follows that with this construction the several segments are self-supporting, there being no strain on the spider or bolts other than that produced by the torque; as a consequence, the spider can be of exceedingly small cross section and in marked contrast to the heavy cast iron or steel structure so common in other multipolar machines, while the labor of fitting is reduced to a minimum, there being no dovetails or other difficult fits to make. The hooks which engage with the clamping bolts not only break joints but alternate in position, leaving spaces between each, equal to the thickness of the iron punchings. These hundreds of spaces enormously increase the radiating surface of the core, which of course reduces the temperature. A careful set of tests shows that with this construction there is absolutely no current generated in the clamping bolts or spiders. This method also adapts itself perfectly to



FIGS. 2 AND 3.—ARMATURE DETAILS OF NEW WOOD CONTINUOUS CURRENT DYNAMO.

armatures of large diameter and any capacity required. To those wishing a more detailed description of this construction we refer to Mr. Wood's patent No. 529,437, of November 20, 1894.

The windings or coils which compose the armature circuit are also of novel construction and present features of extreme simplicity over the bar method of winding heretofore employed. As will be seen from Fig. 3, the coil is composed of four bare wires wound on a former with a heavy copper connector soldered at one end, which makes connections by screws to the commutator segments. The advantages of this construction are first, the soldered joints so common in bar winding at each corner, with their tendency to get loose, are entirely dispensed with, there being but one soldered joint to each coil, in place of five in the old method. Second, as a consequence, the resistance of a turn and the $C^2 R$ losses in the armature are materially reduced. Third, the four naked wires of which the coil is formed present a greater radiating surface in proportion to their area and consequently carry the currents generated in them at a much lower temperature.

After being formed in shape as shown in Fig. 3 they are carefully insulated and placed in position on the core, as shown in Fig. 2, the return ends being soldered into holes in the commutator connector before referred to. The commutator is then slipped on the shaft, each connection being screwed to its proper segment by two screws; as there is no strain anywhere on the insulation and as the voltage between each turn is very low while the ventilation is perfect, it would seem as though such an armature ought to last indefinitely.

The commutator of this machine, shown separate in Fig. 2, is constructed of hard drawn copper with mica insulation, put together by hydraulic pressure, and both it and the brushes and brush-holders are of ample cross section for the currents which the dynamo is intended to generate, and as a consequence it does not heat. The armature circuits are so arranged and connected that either two or four sets of brushes can be used on the commutator; either set can be removed while the dynamo is running, and the remaining set will carry the current without overheating. On a recent test this dynamo was run on a load of 525 amperes at 120 volts for 10 hours, after which careful temperature readings were made; it was then found that the highest temperature in any part of the dynamo was but 35 degrees C. above the room. The dynamo weighs complete 7300 lbs., while the armature weighs but 950 lbs., and at a speed of 650 R. P. M. delivers 500 amperes at 120 volts which can be raised to 140 when required.

ANDERSON, S. C. is to be lighted by the plant of the Electric Light and Water Power Co. at High Shoals five miles from the city.

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CONTENTS.

THE FAN MOTOR.

As much ingenuity has been bestowed on the fan motor of late years, in this country, as upon any other piece of electrical apparatus, without exception. It is peculiarly an American idea, not only in the skill with which it has been rapidly perfected, but the swiftness with which it has been introduced, and the variety of its adaptations. Our climate in summer made it welcome with everybody here, but even in Europe there is a loud call for it and the demand from the tropics keeps up and grows the year around.

Large as the output of fan motors has been in past seasons, there are many indications that the market this spring and summer will be broader than ever. Many reasons exist for this. In the first place, fan motors are cheaper and are better built than in bygone days, and they are certainly far more economical of current. For so small a piece of mechanism, the average efficiency of many of them now popular is amazingly high. Moreover, they will run a whole season through without attention, after first setting up in May; and if any repairs are needed in occasional instances, they are slight. Greater care is now paid to the finish; and the ingenious variety of shape and adjustment enables the installer and customer to meet almost any condition, no matter how small or narrow the room. It is curious to note also, that many men who have become accustomed to fan motors in their offices, have learned to use them in their homes, whenever current is available; and wives and families are found to be equally appreciative of a little steady cool air. Many are the bedrooms also, nowadays, into which fan motors have found their way as pleasant, soothing aids to sleep during the sultry summer nights.

There are still a great number of central station managers who have not worked up a summer fan motor trade and who remain indifferent to its opportunities. We venture to hope that this year all will fall in line. Business is quickly improving, it is true, but no chance to turn an honest penny can be neglected; and far more pennies lie waiting in fan work than would appear at first sight. A single fan motor running eight hours is the equivalent of several lamps in daily current consumption; and we have heard a station financier say that the first intimation he often has that somebody has started up his fan motors is to see the bill rise from $10 to $40 or $50. In other words, just when the income would normally be falling off, on account of the longer daylight, it is quadrupled, and that at a time of day when the generating plant is running but is underloaded. If the station does not itself place the fan motors, there are now plenty of energetic local electrical engineers and supply houses, who should be encouraged. We have heard of one busy agent in New York, who sold 900 fan motors during last season, and who bids fair to beat that handsome record this year.

Not long ago, the direct current fan motor was alone available, and in a limited range of voltages. Now, the flexibility of the direct current motor service has been greatly increased not only by primary batteries but by the persistent and successful efforts made to accustom people to take in stored current just as they do ice and milk. But there is a distinct new field in the alternating fan

motors, several good types of which claim patronage this year and should be looked into carefully by station managers.

Perhaps a word of caution may be offered in regard to installation. In many instances the fan motor line is simply plugged into a lamp socket, but often it is a special piece of work, and we have seen some careless use of flexible cord that must be condemned. Indeed, Inspector McDevitt, in Philadelphia, went so far the other day as to speak of flexible cord as a "bugaboo," so much trouble and alarm did it cause. We believe that people are ready and willing to pay for good, careful wiring work, and that if they get it, they will be induced to make further trial of electricity; so that electric light becomes an entering wedge for electric power, the use of motors an argument for electric heating, and all three an irresistible recommendation for unknown and unfamiliar electrical arts destined each to occupy a vast stretch of profitable territory in the near future.

VICIOUS LEGISLATION ON LIGHTING DEFEATED.

By a vote of 153 to 54, the legislature of Massachusetts on Wednesday last voted to accept the adverse report of the committee to which had been referred a bill giving cities the right to compel existing local electric lighting companies to sell their plants to municipalities at the same price which it would cost to duplicate them. The principal advocate of this measure for the confiscation of invested capital, made in the course of the debate the astonishing assertion that in four years the municipal electric lighting plant of Philadelphia had earned and turned into the city treasury a net income of $3,000,000, besides furnishing the city light for nothing! But the majority of the members were too well informed to be deceived by any such manufactured statistics, as the result of the vote shows.

The uniform policy which has been adhered to by the commonwealth of Massachusetts, in respect to railroads, gas and electric companies and other quasi-public corporations, has been a wisely conservative one, and might profitably be imitated in other parts of the country. The gas and electric companies, for example, are placed under the supervision of a Board of three commissioners; commissioners who are not hack politicians, nor ignorant adventurers, but reputable and trustworthy lawyers, business men or engineers. All complaints of overcharges, insufficient and defective service, and the like, are inquired into; testimony is taken at a public hearing, and such recommendations are made by the Board as circumstances require. It is only just to the electric corporations to say that they have invariably complied at once, with all official recommendations thus made, and in this way the public is always assured of good service and reasonable charges. On the other hand, being absolutely protected against unnecessary and injurious competition (for no new company can infringe upon territory already occupied by an existing company, except by express consent of the Board,—a consent not yet granted in a single instance), are able to devote their earnings to the improvement and extension of their plants.

However much the enterprising promoter and his equally enterprising but more deserving coparcener, the manufacturer's agent, may chafe under these restrictions, there can be no doubt that in the long run they tend to inure to the benefit of electrical interests generally. If the investments of the stockholders in local lighting companies are not protected, the time will come when they will refuse to put a dollar into such enterprises, and the stream of capital will be dried up at its fountain.

The great fact should never be lost sight of, that the entire electrical industry, vast as it is, is wholly sustained and supported by the local companies which deal directly with the public, and there can be no permanent prosperity unless the investors in these local concerns are fairly dealt with.

With such an example before us, it is impossible not to lend a ready assent to the proposition which has lately been made in New York State for the formation of a State Electric Lighting Association, not for the purpose of reading papers or anything of that sort, but solely to protect electrical interests against pernicious legislation, or even the premature enactment of legislation which might prove good after a test of certain conditions still elementary and uncertain. This movement has, we are glad to understand, received the support of Mr. C. R. Huntley, of Buffalo, ex-president of the National Association, and in his hands it will probably amount to something. We believe that sooner or later New York State will have a Lighting Commission like that of Massachusetts, but there will always be the risk that bad men may be commissioners; and it is necessary that the interest itself have an authoritative body to voice its sentiments, assist the weaker brothers by advice and experience, and by all honorable means conserve and promote the welfare of the art. Mr. Huntley may count on the active assistance, in his excellent work, of the electrical press.

THERMO ELECTRIC GENERATORS.

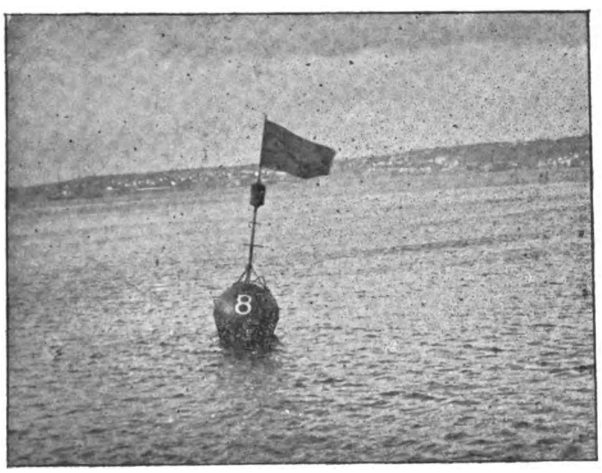
Of all the methods of generating electricity, that in which the current is derived directly by the conversion of heat has always been considered the ideal, just as light without heat is looked upon as the ideal method of illumination. The thermo electric principle up to the present time, however, has yielded such comparatively insignificant results that probably the majority of electricians had begun to look upon that method as scarcely likely to afford even a partial solution of the problem, and in this it must be confessed they were justified, considering that up to within recent dates thermo-electric apparatus has been confined exclusively to the laboratory, and even there used to the most limited extent. It has been truthfully remarked that if the energy, time and brains brought to bear on many recent developments in electricity had been bestowed on the thermo generator it would long before this have gained a place as a commercially practical apparatus. We have good reason to believe, however, that a most substantial step forward has been made in this field by Mr. H. B. Cox, who describes his thermo electric apparatus elsewhere in this issue. Mr. Cox has done well to have submitted his apparatus to a long time test before venturing to bring it before the public, and has thus disarmed criticism, which would have been justified in the light of experience. If the claims made by Mr. Cox, in his intensely interesting article, for his apparatus, are substantiated, and we have no reason to doubt their accuracy, he has produced a mechanism of the most far reaching applicability, and one which brings us a step nearer to the time when electricity will become the universal form of power employed by man.

SUBMARINE TELEGRAPH CABLES.—II.

BY CAPT. S. TROTT, CABLE STEAMER "MINIA."

From what has already been said you may infer that submarine telegraph cables have only a precarious existence, which is more or less true; therefore, every precaution should be taken by those laying them, to guard against impending dangers; for when breaks occur in deep water, the cost of repairs often amounts to fabulous sums.

Two of the first cables laid in the Atlantic lived about seven and ten years respectively, when they were broken in deep water. Two attemps were made to repair one, and one attempt was made to repair the other (these three expeditions cost in the aggregate about $1,000,000); both cables were then abandoned. A few years later a fault was cut out of another cable in mid-Atlantic at a cost of about $400,000. Such enormous expenses and repeated failures forced the late managing director of the Anglo-American Telegraph Company to look for some more certain and expeditious means of getting his deep-water repairs effected; so towards the end of the year 1888 he decided to equip the "Minia" for this important work, she having hitherto been fitted for shallow water only. Time has fully proved the wisdom of that decision, her record since then being without parallel in the annals of submarine telegraphy, she having accomplished about one hundred and twenty repairs during the last ten years, and not a single failure to record against her, although many of them were in the deepest water of the Atlantic, the last of which reaching the enormous depth of 2,597 fathoms. This may be considered the "Minia's" greatest achievement; not only for having many unforeseen difficulties to contend against, which seemed almost insurmountable, but there



CABLE MARK-BUOY.

was the fact, that another ship nearly double her size had the previous summer spent the greater part of four months in the attempt, and had failed.

There has also during last year been another failure to record, by a still larger ship (claimed by themselves to be the best equipped for this work of any in existence). Nearly four months were consumed in their fruitless efforts. The expense of these two failures may be estimated at not less than $800,000 for ships alone, in addition to which must be added the cost of cable required to replace that which was destroyed by hacking them to pieces, in their continued endeavors to recover them.

I will now proceed to explain some of the methods of repairing broken cables. When a break occurs or a fault develops, the first step to be taken is to locate the position of the said break or fault, as the case may be. This is done by electrical tests taken from the stations at either end. In order to make this clear it is perhaps necessary to add a little more to what has already been said regarding its manufacture. The copper conductor consists of a strand of wires of a certain weight per nautical mile. This strand is then covered with a sufficient quantity of gutta percha put on in several layers; when this is completed it is called the "core." It is then immersed at least twenty-four hours in water, as nearly as practicable at a temperature of seventy-five degrees Fahrenheit. The usual tests are then taken.

The coils of core are generally made in lengths of from one to two miles (nautical), and after passing the guaranteed tests they are numbered, labeled and registered, and a record is kept of the portion of the cable into which each length is placed.

The unit of electrical measurement, as most of you are aware, is called an "ohm," and each nautical mile of this core will have a resistance of so many ohms. We will then suppose that we have a cable of 2,000 nautical miles in length, and that the copper conductor has a resistance of three ohms per mile, the total resistance of the whole cable would be 6,000 ohms; then, should our cable be broken, and that from the western station the electrical tests gave a resistance of 2,550 ohms, and from the eastern station 3,450 ohms, we should then have the break located at 850 nautical miles from the west station, and 1,150 nautical miles from the east station. Such a break as described would have a fair amount of copper conductor exposed at each of the broken ends, and would be very easy to locate; but sometimes we have to deal with fractures which, from their peculiar nature, may have one or even both of the ends partially sealed, and offering so much resistance to the escape of current to earth, that, although the break may only be a few miles distant, the electrical measurement may be greater than the resistance of the whole cable. You will therefore see that while in some cases a break or fault may be easily located, there are others requiring all the skill of the expert electrician.

Having located the break in our imaginary cable at 850 miles from its western end, we now refer to chart showing the line of cable, as given by those on board the ship when it was laid. On it should be shown not only the position by latitude and longitude every day at noon, and oftener when necessary or convenient, but it should also show the distance run, and the number of miles of cable paid out; we can then see in what latitude and longitude the 850 miles found by the electrical tests places the fault. Being supplied with this necessary data, the repairing ship (which we will assume is the "Minia," because she has far surpassed all others in this work) now proceeds to the position indicated, and if by celestial observations her position is considered good, she will at once put down a mark-buoy, and having anchored it in a seamanlike manner, it will constitute the basis of operations. Acting on the principle that the greater includes the less, we will suppose that this repair is to be made in 2,500 or more fathoms of water. We then take a series of soundings, to ascertain the accurate depth of water and to examine as much as possible the nature of the bottom on which we have to work. This preliminary survey will also sometimes indicate to us very plainly where the broken ends of the cable may be looked for. This in itself is an advantage, for I can assure you that cables are not always found where they are represented to be by those who laid them, often from no fault of their own, but solely on account of thick weather and unknown currents. As long as cables were laid at a sufficient distance from each other, this was not a matter of vital importance, it being only a question of a longer search; but now that they are so much crowded, it is a different matter altogether; for, when I tell you that we have found a cable more than eleven miles out of its line of position, you may quite understand that it requires more searching for, besides making the difficulty of repairing it much greater, for should other cables be in its vicinity, there is the danger spoken of already of hooking and interrupting a wrong cable, and if this should happen, of course somebody would howl.

LITERATURE.

Telegraphers of To Day. Descriptive, Historical and Biographical. By John B. Taltavall. New York. *Telegraph Age.* Cloth. Large Quarto. 354 pages. Profusely illustrated. Price $5.

This is in reality a most interesting publication, compiled with a good deal of literary skill, and illustrated in reckless profusion with views and portraits that are far above the average. Mr. Taltavall has done the telegraphic industry and fraternity a real service. In some instances one could have wished for a little better perspective in the length of the various articles and sections. This is perhaps to some degree inevitable where the men spoken of furnish much of the crude biographical data themselves, but time will do the sifting, and Mr. Taltavall has put together much valuable material for the future historian of the art. We trust that telegraphers will support the enterprise of our contemporary by liberal subscriptions to the volume.

THE "RANGER" IN A FAN MOTOR GALE.

When Dumas wrote "Le Capitaine Paul," electric fans had not yet been invented, and he was unable to add interest to the battles in which his hero took part by a judicious use of that ingenious piece of mechanism. The authors of "Captain Paul," the melodrama presented at the Fourteenth Street Theatre, New York City, last week, labor under no such disadvantage. They not only have an electric fan, which is, as the programme modestly says, "capable of delivering 100,000 cubic feet of air per minute," but they let it do the delivering. As a result, the sails of the good ship "Ranger" swell before a very real breeze all through the third act. The effect is very fine and thrilling, and the fan motor will probably be regularly billed hereafter in battle dramas.

TELEPHONY.

THE NEW LYNN TELEPHONE EXCHANGE.

The New England Telephone and Telegraph Co. are soon to break ground for their new exchange building on Oxford street, Lynn, Mass., the lot secured being on the westerly side, and a portion of the old Seth D. Woodbury estate. Frank W. Weston, of Boston, is the architect.

The depth, shown in the illustration, is not contemplated at first, but will be added later, as the growth of the service demands. The building is to be of yellow Chelsea mottled brick, trimmed with granite, and will be three stories high including a basement; the Oxford street front will measure 45 feet, and the ultimate depth of the building is to be 60 feet.

The foundations are unusually massive and strong, and allow for high basement rooms. The entrance will be in the centre of the street face, through an arched doorway, flanked by a panel on either side, showing the familiar design of the bell in blue and white enamel, framed in copper. The windows are somewhat deeply recessed, and with their severe, chaste, clear-cut lines, are somewhat suggestive of the classic. The bell design is also repeated in the upper left-hand corner. The basement contains, at the left from the street, the coal vaults and heating apparatus, contained in a general cellar room, a room for the linemen beyond this, with toilet apartments, and at the extreme right the cable shaft.

The first floor is eight steps higher than the street, and the

THE NEW TELEPHONE EXCHANGE, LYNN, MASS.

entrance, seven feet wide, leads to a vestibule at the head of the stairs, on the left of which is the office, with booths at the rear, and on the right the reception room or parlor, fitted with various comforts and conveniences, such as refrigerating closet, wardrobes, toilet rooms and a bathroom at the rear. The second floor will be the operating room, with the switchboards, lining front and sides, and receiving additional light from a large skylight set in copper. The floor of the basement will be of concrete, the stairways of iron, with illuminating spaces, the finish mostly of Washington red cedar with thresholds of cherry, and ash handrails to the stairs. The plastering is over asphalt laid on fireproof wire lathing. The heating will be performed by a Thayer twin hot water heater, and the building will be lighted by both electricity and gas.

MAKE A NOISE AND LIGHT YOURSELF.

Charles F. Kline, who is known as the penitentiary electrician, is recognized as an expert. Kline has developed a new and wonderful idea in electricity that is certain to attract attention. He says:

"If two dissimilar conductors of electricity, subject to slight atomic change under the influence of sound, are joined together after the manner of a pair of thermopile bars and the open ends are insulated by a suitable nonconductor of both sound and electricity, a current is generated when sounds are made in the vicinity of the exposed ends. If two or more such elements are connected together, we have an acoustic battery, and by increasing the number of elements it is possible to operate an ordinary call bell by simply clapping the hands in front of the exposed ends of the battery. If a telephone receiver is placed in the circuit of this battery, articulate speech and other sounds are reproduced in the receiver without loss whatever of tone, pitch or quality, and we have at once a battery and a telephone transmitter combined.

"By enlarging the surface of the exposed ends of the elements and by employing very loud sounds as an excitant a current might possibly be generated which would be of the required force and quantity to operate motors. Shops might be lighted to some extent by the noise of the machinery. A clock might be made self winding by the sound of its ticking, and then perpetual power would become as common as spring power. What the internal resistance of this battery would be when working under the influence of extraordinary loud sounds remains to be determined. But for most purposes the resistance would not amount to much, the materials from which the bars are made being made conductors.

"The noise made by walking on the floors or by shutting the doors might be made to charge small storage batteries, and electricity on tap would become as cheap as water. The materials from which the bars of this battery are made are not to be found in commerce."—*Cleveland, O., Plain Dealer.*

"SASSING" OVER THE TELEPHONE.

The telephone has caused more quarrels and wretched differences of opinion than any other modern invention. It is so easy, says the *N. Y. Evening Sun*, to tell a man who has the receiver at his ear several miles away what you think of him, because there is so much time to cool off and come to your senses afterward. Capt. Rogers of the Brooklyn Navy Yard and Lieut. S. H. Moses of the Marines were the victims of the telephone lately, and now the Lieutenant is threatened with a court martial because he "sassed" the Captain over the wire. In the latter's presence the Lieutenant, no doubt, would have been overawed by authority, and the discipline of the service would have been maintained.

THE NEW CHICAGO TELEPHONE RATE SCALE.

The Chicago Telephone Company will shortly have in operation a schedule of rates, it is announced, as low as $5 a month, available, it is estimated, for at least 25 per cent. of the total number of its present patrons. The cut is to be accomplished by the creation of what are called "party circuits." General Manager Hibbard says that the rates will be on a sliding scale. Where there are two instruments on the circuit the rent will be $75 yearly; for three the cost to each will be $70, and where there are four or more the rate will be $60. By this means he expects to increase the residence patrons from 3,000 to 6,000. In the business section hundreds of new subscribers are also expected to come in on the party lines.

TELEPHONE NOTES.

NORTHFIELD, MINN.—Messrs. Tennant Bros. are perfecting arrangements for a new telephone system at Northfield.

PLAIN CITY, O.—The Home Telephone Company of Plain City has extended its lines.

PAXTON, ILL.—The Paxton Telephone Company has put up a 60 telephone switchboard at the central office.

GREENCASTLE, IND.—Articles of incorporation have been filed with the Secretary of State by the Greencastle Local Phœnix Telephone Company, capital stock $8,000.

SUNBURY, PA.—The Anthracite Telephone and Supply Co. and the Shamokin Valley Telephone Co. have both applied for right of way in this town.

VINCENNES, IND.—The Knox Phœnix Telephone Company, capital stock, $15,000, has been formed for operating a telephone system in Vincennes.

ROCK RAPIDS, IA.—J. D. Wilson & Co., have been granted a 20-year telephone franchise and the work of construction will begin at once.

CAMDEN, N. Y.—A telephone exchange with some twenty subscribers is in operation in this village. It is managed by M. P. Osborne of the electric light station.

GUTHRIE, OK.—A company with $1,000,000 capital has been organized here to build a mammoth telephone circuit, connecting all the towns in seven counties of this section. Stock has been subscribed and the line will be in operation in thirty days.

TAMPA, FLA.—The board of directors of the local telephone company have elected the following officers: S. J. Drawdy, president; A. C. Clewis, vice-president; John Trice, treasurer, and Chas. H. Keller, secretary and general manager.

ORANGE, VT.—The Vermont Telephone and Telegraph Company, of which Col. A. C. Brown, of this city is president and general manager, has purchased of the New England Telephone and Telegraph Company that part of their telephone lines which are in the towns of Orange and Washington.

THE UNIVERSAL TELEPHONE.

Our illustrations represent the instruments now being manufactured by the Universal Telephone Co., of Indianapolis, Ind., who have set their aim to produce apparatus of as high a standard as quality of material and care in manufacture can produce.

Fig. 1 represents their model "B" wall telephone set in which

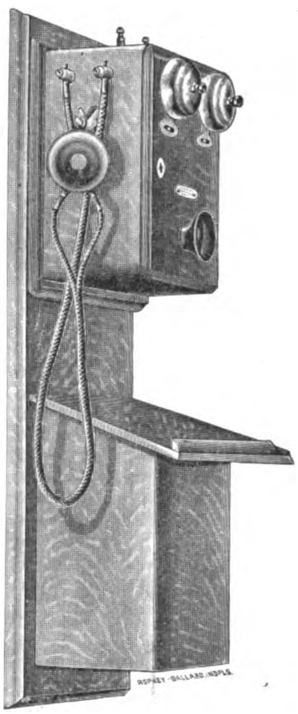


Fig. 1.—The Universal Telephone, Model "B."

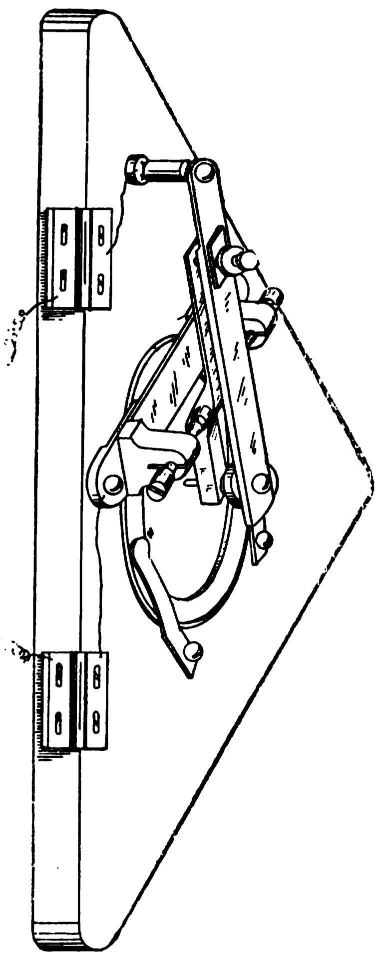


Fig. 3.—The Universal Telephone Transmitter.

the transmitter is placed in the upper magnet box. The instrument includes a lightning arrester and a magneto which will ring through 10,000 ohms resistance. A semi-automatic switch is provided, all the contacts of which are made of platinum.

The company's telephone, model "C" illustrated in Fig. 2 is

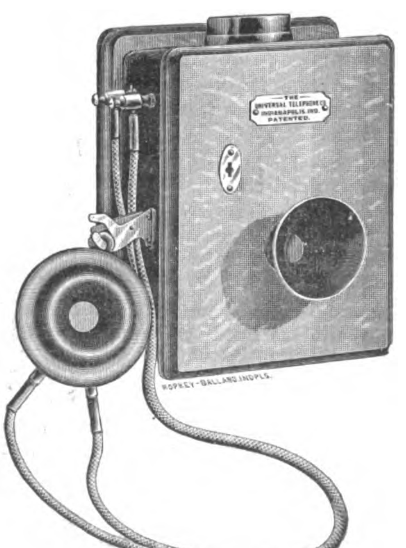


Fig. 2.—The Universal Telephone, Model "C."

adapted specially for short line work in factories, offices, hotels, etc.: it occupies a space of only 4 by 5 inches by 2 inches deep.

The transmitter employed in all these instruments is shown in Fig. 3. It has been constructed with the special object in view of securing easy and permanent adjustment. It is a frequent experience in operating telephones which are constantly in use, to find that when speaking too loudly in order to overcome some cross or fault in the line, or because the battery power is weak, or where, from other causes, the ordinary tones of the voice are entirely unintelligible to the listener, the electrodes are thrown entirely apart, thus preventing any vocal sound whatever from being transmitted.

By the compensating contact attached to this telephone, instead of any tendency to throw the electrodes apart by loud speaking, the action of the reacting lever causes them to receive a closer pressure by the increased amplitude of the vibrations of the diaphragn, and thus transmits the exact modulations of the sound waves thrown thereon.

It may be added that the patents under which the Universal Company are working are by no means of recent date, but embody improvements which have not been used heretofore.

TELEPHONE NOTES.

Monmouth, Ill.—The Monmouth Telephone Exchange Company has been formed; capital stock, $10,000; incorporators, D. S. Hardin, R. Laham and J. D. Diffenbaugh.

Rockford, Ill.—Fred W. Keith, who represents the Strowger telephone has made a proposition to the Rockford Telephone Company to put in an exchange and rent it to the Rockford Company.

Utica, N. Y.—As soon as the franchise is approved by Mayor Gibson, the Central New York Telephone Company will proceed with the work of constructing subways for its wires in the business quarter of the city.

Abbeville, La.—The Teche and Vermillion Telephone line's new tariff has gone into effect, making a reduction of 33⅓ per cent. to all points. This is due to the reduced rates given by the Bell people.

Bucyrus, O.—A new company has been given a franchise, and unless the old company makes a decided drop in rates, the business public may go over to the new line, which would practically close the Central office.

Mitchell, S. D.—Wm. M. Smith appeared before the council representing the Mitchell Telephone Company asking for a twenty year franchise to erect poles and wires and to conduct their business in the city of Mitchell.

Kokomo, Ind.—Owing to the competition of the Laclede Electrical Company at Kokomo, the Bell Telephone Company has reduced its rates 50 per cent. Prices now range from $1.50 to $[illegible] per month.

Ishpeming, Mich.—A new telephone company has begun operations at Ishpeming and Negaunee, and contracts are now being made at the rate of $30 for business places and $15 for residences.

Los Angeles, Cal.—The Southern California Telephone Company of this city and county has been formed; capital stock $100,000 of 1,000 shares of $100 each. Directors, James C. Kays, Lewis A. Groff, Martin C. Marsh, T. B. Newton and William R. Burke of Los Angeles.

Anderson, Ind.—The Anderson city council has granted a franchise to the Harrison Telephone Company for a telephone service in this city. The telephone exchange is to be working July 1, with not less than 300 telephones. The Bell Company announces that it will cut its rates to meet competition.

Dubuque, Ia.—The Central or Bell Telephone Company has cut rates and announces that telephones will be given for nothing should a rival exchange be undertaken by the Harrison or any other company. It also promises the long distance telephone between Dubuque and New York via Chicago.

Elkton, Md.—The Cecil Telephone and Telegraph Company, of this place, will on July 1st reduce the yearly rental for the use of their instruments from the present rate of $50 per year for business places and $36 for private residences to $30 and $20 respectively.

Baltimore, Md.—The officers of the new Home Telephone Company are Franklin Noble, of New York, president; W. S. Risley, of Canton, N. J., and Dr. Chas. H. Ware, of Baltimore, vice-presidents; Robert Baker, treasurer, and W. J. Atkinson, general manager.

Stockton, Cal.—Articles of incorporation have been prepared for a new telephone company that proposes starting business at once. There are to be five directors, four of whom are local men and the fifth a Boston capitalist. The capital stock of the concern is $100,000, of which $50,000 has already been subscribed.

ELMER, PA.—This borough is to have telephone service.

PIERRE, S. D.—The city council has granted a seven-year telephone franchise to George S. Holmes.

LENOIR CITY, TENN.—C. B. Hall and J. L. Griffiths have surveyed a prospective telephone line to Unitia.

ASHLAND, O.—Mt. Vernon parties have been granted a telephone franchise in Ashland.

JOHNSTOWN, PA.—E. B. Cresswell is building a $15,000 plant for the new Johnstown Telephone Company.

COLUMBUS, IND.—The Citizens' Telephone Company, of Columbus, has been incorporated with $15,000 capital.

CANASTOTA, N. Y.—Local capitalists are organizing a telephone company to secure lower rates and more general service.

TECUMSEH, NEB.—A local telephone company is being organized at Tecumseh and the citizens propose to patronize it exclusively. One hundred men will take the stock at $30 a share.

CRYSTAL SPRINGS, LA.—The King Price Telephone Company have completed their line to this place which connects the towns of Wesson, Beauregard, Hazlehurst and Martinsville.

FORT WAYNE, IND.—The total cost of the improvements now being made in this city by the Central Union Telephone company will be $30,000.

REED CITY, MICH.—The Telephone and Telegraph Construction Company are setting their poles and will soon string the wires, when Reed City will have a telephone exchange.

LAURENS, S. C.—A commission has been issued to the Laurens Telephone Company, the capital stock of which is to be $1,000, divided into 200 shares. The corporators are E. H. Wilkes, J. N. Wright and W. R. Richie.

LONG BRANCH, N. J.—The Phœnix Telephone Company proposes to establish a telephone service at Long Branch. The rates will be $24 a year. Already a number of subscribers have been secured.

ALBIA, IA.—The city council of Albia has granted a franchise to the Harrison Telephone Company, and work is to be commenced within thirty days. The terms are $2.25 per month for business houses and $1.25 per month for residences.

NEW RICHMOND, IND.—A company is being formed to extend the New Richmond and Linden telephone line to Wingate and Newtown, and thus connecting it with Indianapolis via Wingate and Crawfordsville.

GRAND RAPIDS, MINN.—The wires for a telephone line between Grand Rapids and the government dams on Winnibigoshish, Leech and Pokegama lakes have been strung and in a few days communication will be established.

GOSHEN, IND.—The commercial exchange has closed a contract with George W. Beers of Ft. Wayne to operate a telephone system in this city under the franchise granted the exchange by the common council. Beers will use the Anthony telephone and is bonded to complete the system by July 1.

GLENWOOD SPRINGS, COL.—There is probability that Glenwood will be connected with the outside world by telephone. T. J. Tierney, of Grand Junction, superintendent of the Colorado Telephone company, is now making a preliminary survey for the route over which the line will be built.

BELL TELEPHONE OUTPUT.—The returns of the American Bell Telephone Co. show a gain in instrument output since December 20 of 15,354 telephones. In the same period last year there was a net deficit of 2,963 instruments. This is a most unmistakable evidence as to the turn in the business tide.

PEORIA, ILL.—The International Construction Co. have applied to the City Council for a franchise to build and maintain a telephone system for twenty years. They intend to put in the Harrison system. The company have given out rates as $36 per year for business houses and $18 for residences, or about half of the present rates.

SANTA CRUZ, CAL.—The Rice Telephone Company has elected the following temporary officers: C. A. Rice, President and General Manager; F. W. Swanton, Vice President and Assistant Manager; W. E, Peck, Secretary; W. H. Lamb. Treasurer; C. A. Rice, W.H. Lamb, Jos. Schwartz, F. W. Swanton and W. E. Peck, Directors.

HARRIMAN, TENN.—Dr. C. T. Cory, Walter H. Julian, M. L. Dame, A. R. McKinzie, and J. D. Buck, will apply for a telephone franchise at once. The charter provides that it shall not be operated for profit but for the mutual benefit of the citizens of Harriman. No one shall become a stockholder except he operates or uses a telephone. The cost of instruments and erection will be about $25 each, and the expense for operating about $12 per year for each instrument.

AUSTIN, TEX.—The Belton Telephone Company has been formed with capital stock of $20,000. Incorporators: N. K. Smith, Charles B. Smith and J. Z. Miller, Jr.

CLARKSVILLE, N. Y.—The East End Telephone line has just been consolidated with the West End Telegraph and Telephone line.

BATH, N. Y.—Work has been commenced for the construction of a long distance telephone line between Williamsport, Pa., and this village.

HAMILTON, O.—The commisioners have granted Frank M. Hughes and others a telephone franchise over the Princeton pike, from Hamilton to Hughes' Station and further if necessary.

SHERIDAN, WYO.—A telephone company has been incorporated at Sheridan with a capital of $3,000. It is a local company and will put up its own line.

NIAGARA FALLS, N. Y.--The Bell Telephone Company have formally offered to bury their wires on Falls street if the other companies having wires can be induced to do likewise.

ATTLEBORO, MASS.—Geo. Emmett and others have formed a syndicate to supply the Attleboros with a new telephone system at one-half the cost now paid for the use of telephones.

BELSANO, PA —The citizens of Belsano will furnish the holes and poles, and Mr. E. B. Creswell the wire and other material for a telephone line between that place and Twin Rocks.

COUNCIL BLUFFS, IA.—Eli Brown, C. J. Willow and J. E. De Lee, the first of Council Bluffs, the latter of Omaha and the other of New York, have filed articles of incorporation of the Wizard Telephone company. The articles provide that the incorporation shall be for a period of twenty years; that the company shall have a capital stock of $100,000.

CRANFORD, N. J.—Articles of incorporation have been filed by the Cranford Mutual Telephone Company. The incorporators of which are, James Rodgers, George W. Littel, Wilfred C. Allen, Joseph Watterson, William J. Lansley, Henry C. Thornton and J. Rodgers. The capital stock of the company is $10,000. The company will begin business with $1,000.

AMERICUS, GA.—There is a plan on foot to connect a dozen of the small cities and towns with Americus by telephone. The towns include Smithville, Sumter, Bronwood, Dawson, Weston, Shellman, Richland, Parrott's, Preston and Plains, thus making a complete circuit. It is estimated that total cost will not exceed $2,000.

NEWARK, O.—Representatives of the Newark Telephone Company and Judge James Thomas, of Chillicothe; L. P. Lewis and W. Z. Evans, of Delaware; Jerome Penn and J. F. McLain, of Washington C. H., have taken steps toward forming an organization of all local telephone exchanges in Ohio to oppose the Central Union Telephone Company.

NEW HAVEN, CONN.—There is now before the state Legislature a resolution for the incorporation of a telephone company to be known as the People's Telephone Company. Ex-Gov. T. M. Waller, J. E. Bowles, J. Irving and J. J. Lawton are named as incorporators, with capital not exceeding $500,000, the place of business to be at this city.

MARTINSVILLE, IND.—The Southwestern Telephone Company of Martinsville has been incorporated. It has a capital stock of $5,000 and is organized for the purpose of operating a telephone system in the counties of the southwestern portion of the state from Marion to the Ohio river. The directors are Clark S. Crary, Sarah P. Crary and Charles W. Barkhurst.

WESTMINSTER, MD.—The Western Maryland Telephone Company of Carroll county has been incorporated here by Messrs. Charles E. Fink, A. H. Huber, Samuel Roop, H. S. Roberts, Fred D. Miller, Joseph W. Smith, Theo. F. Englar, P. J. Bennet, J. M. Reifsnider. Charles H. Vanderford, Joseph T. Hering and Granville S. Haines. The capital stock of the company is $10,000, divided into 400 shares.

IOWA CITY, IA.—The board of directors of the Iowa Union Telephone Company, composed of G. W. Cable, F. H. Griggs, E. E. Cook, A. Burdick, Joe R. Lane, E. S. Carl, and A. F. Cutter of Davenport, Alonzo Burt of Kansas City and Arthur G. Fuller of Chicago, have organized by electing George W. Cable president, F. H. Griggs vice-president, A. F. Cutter secretary, and E. S. Carl treasurer.

HAGERSTOWN, MD.—At a special meeting of the city council of Hagerstown Dr. P. D. Fahrney, of the Interstate Telephone Company of Frederick, who purchased the charter of the Citizens' Telegraph and Telephone Company of Hagerstown, requested permission to build a system in Hagerstown, plant poles and lay underground tubes for wires. The company has been granted a franchise in Frederick City. Dr. Fahrney says they will put in telephones for $25 a year to business houses and $15 a year to private houses.

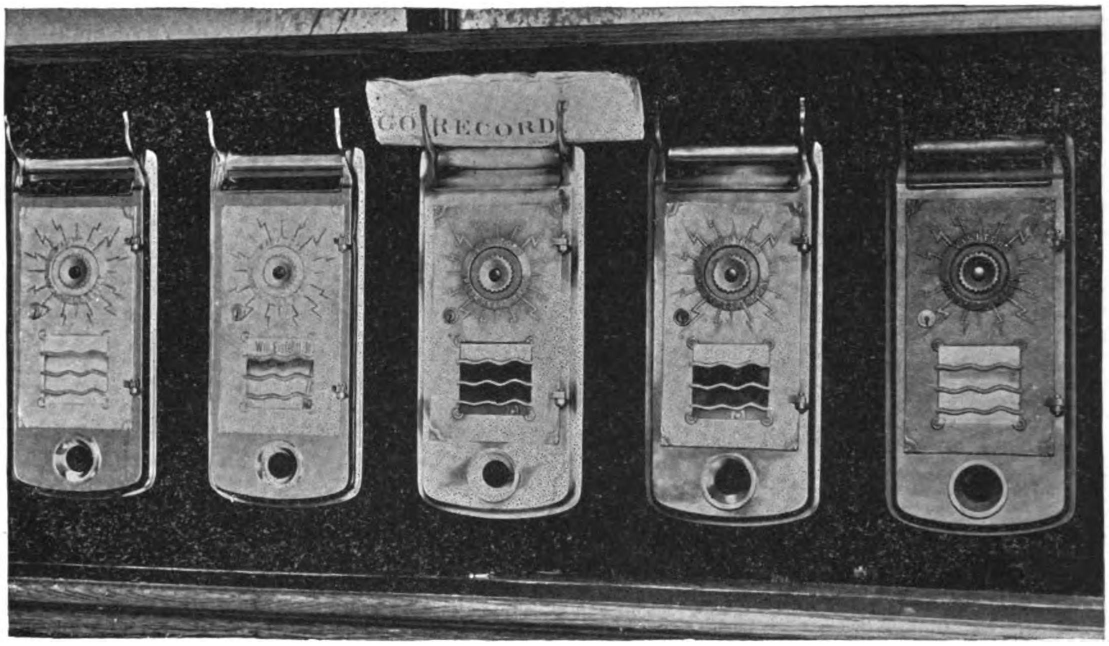


Fig. 1.—The Belding Electric Alarm Mail Box.

THE BELDING ELECTRIC ALARM MAIL BOX.

While the method of getting mail ready for distribution at the general post offices in all large cities has been brought to an extremely high state of efficiency, very little improvement seems to have been made in the way of providing a safe and efficient receptacle for mail left at houses, flats, stores, etc. Generally an

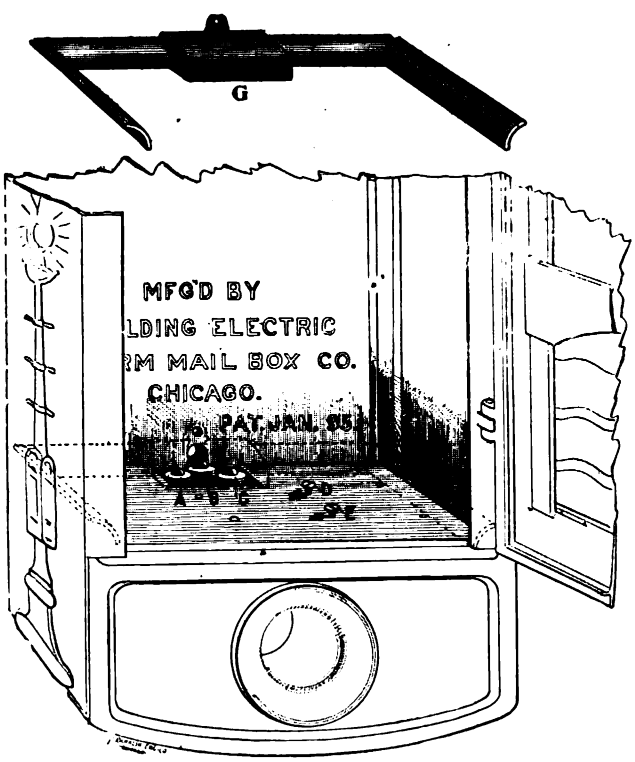


Fig. 2.—Belding Electric Alarm Mail Box.

ordinary slot in the door through which the postman pushes the mail is deemed sufficient, in some cases a wooden or tin box with an apology for a lock is provided; and in a great many places the conventional metal box, set in flush with the wall in entrances to apartments can be found. In all of these cases it is an easy matter for unauthorized persons to abstract letters or otherwise tamper with the mail with little fear of detection. To overcome these defects and provide a practically perfect receptacle for mail, Mr. Edward C. Belding, a Chicago inventor, has recently devised an ingenious, yet simple electric alarm mail box, which is now being rapidly introduced.

The box which is illustrated in perspective in Fig. 1, consists of a solid metal box of a size to hold a Number Nine envelope. Every opening of the box is protected by an electrical connection, shown in Fig. 2, so that whenever the flap of the box is raised or the door opened, an electrical bell is set ringing in the house or flat, and registered on the annunciator, should there be one on the premises. In addition to this, the base of the mail box contains an automatic sounder or buzzer, which works in unison with the house bell. The base of the mail box also contains a speaking tube mouth piece, and on the face of the box a visitors' push button is provided for callers.

The electrical connections are extremely simple, it being merely necessary to remove the ordinary push button and connect the two wires to binding posts A and C in the base of the box, Fig. 2, a third binding post B being provided for the buzzer connection above referred to. The adjusting screws D E are provided for adjusting the vibrator to work in unison with the house bell or annunciator. A solid metal casting G covers all connections when the box is in place.

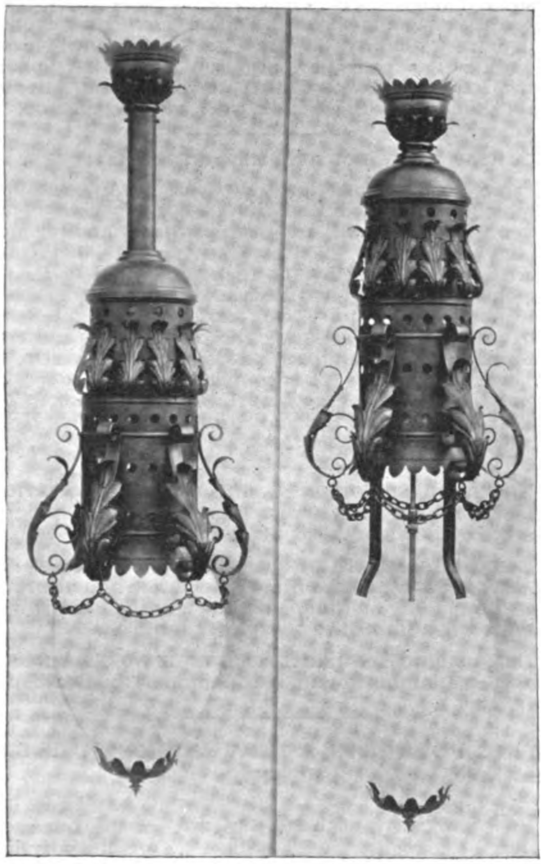
The boxes are all made of standard size and are furnished in any desired finish, such as oxidized silver, nickel plate, old copper, polished brass, etc. The Belding Electric Alarm Mail Box Company, of 441 and 443 Unity Bldg., Chicago, is introducing the device and is meeting with much success. The postal authorities recommend it, and architects throughout the country are fast including the boxes in their specifications.

ELECTRIC LAMPS AND MINE GASES

Mr. John Haldane, of Oxford, England, has made some valuable experiments upon the action of mine gases on the respiration. His experiments are described as follows:—Along with an exploring party he advanced along a low heading in a 2-ft. seam into an atmosphere which analysis on the spot showed to contain large quantities of "black-damp." When the percentage of oxygen had fallen to 17.64 an upright candle was extinguished, at 17.23 a lamp went out, at 17.05% a candle held horizontally, with the wick spread out failed to burn. Pursuing his investigations by aid of the electric lamp he found that at 15.3% of oxygen and 3.38% of CO_2 his respirations began to be deeper, and at 9.6% of oxygen and 7.32% of CO_2 there was violent panting; at 7% of oxygen consciousness would probably have been lost. Dr. Haldane thus proves that there is a wide margin between the point of extinction of a lamp and the point of danger to life; but it must also be observed that if all "black-damp" is similar to that which he has examined, there is a fairly wide margin between the point at which panting begins and the real danger point. A miner, provided with an electric lamp, could therefore penetrate with impunity, or escape through atmospheres containing at least thrice as much black-damp as would extinguish a lamp or candle, and the difficulty of respiration would give ample warning even if the electric lamp did not. An old miner, who accompanied this party, was of opinion that the danger of the extinction of a lamp in "black-damp" goes far towards counterbalancing the advantages of the warning given by the extinction.

THE FORT WAYNE ELECTRIC CORPORATION'S NEW ORNAMENTAL ARC LAMPS.

The new Wood ornamental lamps of the Fort Wayne Electric Corporation deserve more than passing notice, as they contain a novel feature which facilitates trimming. Fig. 1 shows the lamp ready for burning, while Fig. 2 shows the ornamental casing raised, exposing the feed rod and carbon holders for trimming, completely obviating the difficulty so common in other ornamental lamps in keeping the feed rod clean and adjusting the carbons in line. This casing is held up in position by a bayonet joint at the top of the suspending tube where it in no way interferes



FIGS. 1 AND 2.—NEW FORT WAYNE ORNAMENTAL LAMPS.

with the attendant during the act of cleaning the globe or trimming the lamp. When it is lowered into place, as in Fig. 1, it acts as a most effective spark arrester.

The design of these lamps, and in fact the whole apparatus from an artistic point of view, leaves nothing to be desired. They are manufactured either single or double, of any candle power, and wound for constant current, constant potential or street railway circuits, while the cases are finished either in brass or old iron.

THE VANCE ELECTRIC CO.

The Vance Electric Company of New York City, has been formed to carry on a business of general contractors and electrical engineers for all classes of electrical construction work; capital, $10,000. The directors are Arthur S. Vance, of Brooklyn; John H. Cheever, Elizabeth Cheever, Charles C. Guiteau, of New York City, and Charles A. Allen, of Dover, N. J.

THE ADAMS-BAGNALL ELECTRIC CO.

A number of the leading employees of the Brush Electric Co. of Cleveland, have withdrawn and have formed the Adams-Bagnall Electric Co. of that city, with a capital of $150,000. The officers of the company are C. G. Hickox, president; G. W. Howe, vice president; L. H. Rogers, manager; S. E. Cox, secretary; C. W. Phipps, superintendent, with T. E. Adams in charge of lamp production and E. J. Bagnall, in charge of dynamo and motor construction. This is a decidedly strong team.

OBITUARY.

W. J. RICHARDSON.

William J. Richardson, who for years was Secretary of the Atlantic Avenue Railroad Company up to the time it was purchased by the Brooklyn Traction Company, and who was a Director in the latter organization, died at the Presbyterian Hospital, this city, last Saturday from spinal meningitis after an illness of seven weeks. He was a Director of the company, and the President of the Atlantic Avenue Railroad Employees' Mutual Aid Association, an organization started by his father, the late William Richardson. The two positions clashed during the recent strike, and he was attacked with nervous prostration. He was compelled by the action of the officers of the Brooklyn Traction Company about a week ago, while sick in the hospital, to retire from the Board of Directors. It was said that there was an agreement between William Richardson and the new syndicate by which his son was to continue to act as Secretary, but after his father's death no such agreement could be found, and Benjamin Frick was elected Secretary. Mr. Richardson had been Secretary and Treasurer of the American Street Railway Association since 1882.

Mr. Richardson was married in 1878 to Miss Mary Carrington Raymond, the daughter of John H. Raymond, President of Vassar College. He leaves a wife and five children, three daughters and two sons.

The funeral took place from the Hanson Place Baptist Church on Monday afternoon. Mr. Richardson's death will be deeply regretted throughout street railway circles.

FINANCIAL.

A SLOW BUT GENERAL RECOVERY.

The favorable conditions that began to manifest themselves a month ago are to-day more evident, while all the influences for betterment are stronger and wider in their range. The net March returns of steam railway operation are uniformly encouraging; those of street railways are even more cheerful. The higher prices of some staples have led to improvement elsewhere, and there are indications that buying may soon become general on the part of those who are too shrewd to wait for the inevitable hardening and stiffening in the produce and metal markets. There has been large foreign buying of American bonds, and best of all some 75,000 workpeople have within the past week or two enjoyed an advance of wages. In short, the recovery is slow but sure.

Of Western Union 15,985 shares were sold, up to 89½, a gain of ½; General Electric, 19,670 up to 34½, a gain of ⅛. Bell Telephone has risen again to 183. Commercial Cable is quoted at 140.

BIDS WANTED ON A MUNICIPAL PLANT FOR CHATTANOOGA.

Mr. T. J. Gillespie informs us that the city of Chattanooga is inviting bids up to June 3 for the erection of a municipal plant, and also for lighting the city with electricity and supplying from 175 to 250 arc lights. Mr. J. O. Martin is the chairman of the Light Committee.

WAINWRIGHT FEED WATER HEATERS.

Orders for Wainwright feed water heaters of the following sizes have been placed within the past thirty days by the Taunton Locomotive Manufacturing Company: One for the Washington Mills, of Lawrence, Mass., containing 1,000 sq. ft. of heating surface, or 3,000 H. P., one for the Newberry (S. C.) Cotton Mills of 400 sq. ft. or 1,200 H. P.; one for the Consolidated Electric Light and Power Co, Birmingham Ala., of 600 sq. ft. or 1,800 H. P., and one for the Maryland Steel Company, Sparrows Point, Md., of 325 sq. ft. or 975 H. P., together with about 2,000 H. P. of smaller sizes.

THE BREEZY "LUNDELL."

The Central Electric Company, 173 Adams St., Chicago, are again directing attention, in a timely way, to one of their important specialties, the Lundell fan motor. We learn from them that of the hundreds of these comfort dispensing articles which they sold last season, they had no complaint whatever. This seems a remarkable record considering the hap-hazard manner in which motors, as a rule, are often treated by the user. However, the Lundell fan motor is built to stand a great deal of reckless ill use, and this probably accounts for the unvarying satisfaction they give to central station managers. The Central Electric Company has issued a pithy but brief catalogue illustrating the many forms in which the motors are made, giving prices and other desirable information.

PERSONAL.

THE WESTERN UNION'S "GRAND OLD MAN."

Gen. T. T. Eckert.

ON April 23, Gen. Thomas T. Eckert, President of the Western Union Telegraph Company, celebrated the seventieth anniversary of his birth. The employés in the Western Union Building, at 195 Broadway, took advantage of the day to present a testimonial of their regard for Gen. Eckert personally, and their appreciation of his services as the President of the company. When he reached his office at the usual hour he was met by a delegation of more than thirty of the officers. They represented every department, and each one wore a flower on his coat. All congratulated the General on having reached this anniversary in health and strength.

Supt. W. J. Dealy of the Commercial News Department then presented Gen. Eckert with a beautiful floral offering, the testimonial of the employés, accompanied by one of his own inimitably neat boutades of oratory.

Gen. Eckert was visibly affected by the tribute paid him, and he expressed his appreciation briefly. It was the first time since his connection with the company that such a demonstration had been made by the employés.

The General's hair has assumed the dignity of color consistent with his years, but otherwise his appearance has changed little in the last twenty-five years. His energy in promoting the development of the telegraph is still unflagging. The inhabitants of the civilized world are to-day enjoying privileges of quick communication which are due to his tireless efforts, and without which the natural force of telegraphic development might not of itself have afforded them for years to come. It is to be hoped that another decade of years will find Gen. Eckert enjoying the same vigor of health and the same activity in his life's work that are his reward to-day.

MR. L. HORTON, JR., has been appointed superintendent of the Philadelphia Reading & Pottsville Telegraph Co., vice E. R. Adams, deceased, with headquarters at Reading, Pa.

MR. J. C. HENRY, the well-known electric railway inventor, will, we regret to learn, be unable, on account of ill health, to resume his residence in the East. He had a beautiful residence at Westfield, N. J., but had to spend the winter in Colorado, and now finds it necessary to make that state his home. In the rare, crisp air of Colorado his health is excellent, and it is to be hoped and expected he will there reach fullness of years.

MARRIED.

TOLLES-ROBERTS.

We have the pleasure of announcing the marriage of Miss Annie Louise Roberts to Mr. Charles L. Tolles, the popular representative of the Jewell Belting Co., of Hartford, Ct. Mr. Tolles has been in this business now for several years paying particular attention to the electrical trade, is a familiar figure at all the electric light and railway conventions, and has a host of friends among the electrical fraternity, who will gladly join us in offering their sincere congratulations on the happy event. Mr. and Mrs. Tolles will be at home after May 29th, at 18 Marshall street, Hartford.

SHAINWALD-BARNARD.

Miss Julia H. Barnard, of San Francisco, was married on the 24th ult. to Mr. J. C. Shainwald, the popular western manager for the Standard Paint Company. The ceremony took place at the Auditorium, Chicago, a number of relatives and intimate acquaintances being present. The happy couple left for an extended wedding trip along the northern lakes, and after their return will be at home at the Yorkshire, Chicago. THE ELECTRICAL ENGINEER extends its congratulations and best wishes to Mr. and Mrs. Shainwald, and hopes that the future may have nothing but joy and happiness in store for them.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRICAL SOCIETY.

The April meeting of the New York Electrical Society was fixed for the 25th ult., when Mr. T. L. Willson was to have delivered a lecture on acetylene. At the last moment Mr. Willson had to leave for the West, and Mr. Edward Durant kindly filled the gap by repeating before the Society of the 24th inst. his lecture given on the 16th before the Brooklyn Institute, on "The Manufacture in the Electric Furnace of Diamonds, Rubies, Aluminum and Acetylene Gas."

NATIONAL ELECTRIC LIGHT ASSOCIATION.

President Wilmerding is to meet the members of the Executive Committee at the Grand Central Palace, Lexington avenue and Forty-third street, this city, on May 4, at 7 P. M.; when representatives of the electrical press have also been invited to dinner with the officers. It is understood that the proposal to have a good electrical exhibit at the Palace next year will be taken up.

A NEW HOME FOR THE FRANKLIN INSTITUTE.

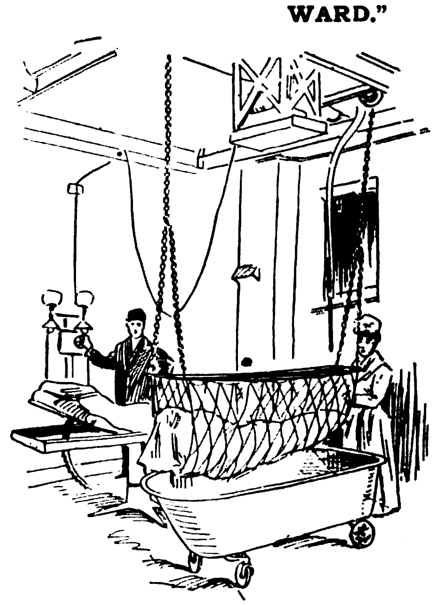
At a special public meeting last week in Association Hall, Philadelphia, the venerable Franklin Institute, whose history is interwoven with that of all American discovery and invention in the arts and sciences for the last seventy years, took steps to secure a new home worthy its past and equal to its future. The plan outlined by President Wilson is for a 12-story building, with fine auditorium, library, etc., and with several floors for offices, to cost about $1,500,000. The meeting was addressed by several representative men, such as Coleman Sellers, Dr. Henry Morton, etc., and letters of encouragement and support were read from such men as President Low, of Columbia College; Prof. Elihu Thomson; President Gilman, of Johns Hopkins; Profs. Thurston, Hutton and others.

THE NEW ENGLAND COTTON MANUFACTURERS ASSOCIATION held its Providence meeting last week, carrying out the programme given in the ENGINEER of April 24.

THE TEXAS GAS AND ELECTRIC MEN are meeting at Austin, Tex., on May 22 to organize a State Association on business lines. It is backed by brainy and influential men in the local companies, and bids fair when formed to be a power for good.

THE TELEGRAPHIC HISTORICAL SOCIETY OF NORTH AMERICA will hold its first annual meeting in Washington at the Board of Trade Rooms, on May 1.

ELECTRIC POWER IN A NEW YORK "SUNSTROKE WARD."



Motor Lift in "Sunstroke Ward."

As a lesson in favor of the fan motor as an alleviative of heat and atmospheric oppression in the summer, we note an article in the *New York Times* showing the elaborate measures necessary in the city hospitals for dealing with cases of sunstroke. The Hudson Street Hospital for example has a most generous outfit for dealing with this class of cases, and its downtown position renders its work highly important, in view of its nearness to the ferries, big factories, elevated lines and office buildings. The cut herewith shows the use of electric power in the "Sunstroke Ward," used in connection with a lift for handling patients and the rolling bath, shown underneath the poor victim in the sling. It is understood that this intervention of the electric motor does much to render easy and safe the treatment and transfer of patients. But after all, it is better to enjoy a cool fan motor breeze and stay well than succumb to the heat and need the assistance of electric power in recovery. At Hudson Street, the Detroit Motor and Edison street circuit are used, the elevator motor being 15 H.P. and the ventilator motors 5½ H.P.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 23, 1895.

Accumulators:—

Storage Battery, M. Moskowitz, Newark, N. J., 537,989. Filed May 7, 1894.

The plates or elements are spirally wound in the manner of a clock spring, to allow a large amount of contraction and expansion of the elements.

Alarms and Signals:—

Electric Guest Call, F. O. Smith, La Crosse, Wis., 537,860. Filed June 2, 1894.

Details of construction.

Method of and Apparatus for Protecting Electric Circuits, J. M. Oram, Dallas, Texas, 537,932. Filed Jan. 15, 1895.

Consists in varying the normal current continuously and automatically, according to a plan or pattern, changing the character, nature or arrangement of said plan or pattern at pre-determined intervals, and reproducing such arbitrary variations upon an indicating instrument at a distant point.

Working of Railway Points and Signals by Electricity, I. A. Timmis, London, Eng., 538,136. Filed June 9, 1894.

Conductors, Conduits and Insulators:—

Coupling for Electrical Connections, J. M. Faulkner, Philadelphia, Pa., 537,920. Filed Aug. 9, 1894.

Claim 1.—The tubular sectional coupling, arranged to be secured on and embrace the line wire or wires one section of which has a mercury cup or depression, the other section having an opening through which a side line can be inserted into said mercury.

Insulated Conductor, W. M. Habirshaw, New York, 538,020. Filed Oct. 16, 1894.

For description see page 400 this issue.

Separable Terminal for Conductors, D. N. Osyor, Columbus, Ohio, 538,083 Filed Nov. 28, 1893.

Dynamos and Motors:—

Controlling Mechanism for Electric Motors, C. H. Richardson, Philadelphia, Pa., 537,994. Filed June 9, 1894.

Method of control for dental motors.

Commutator Brush, L. Boudreaux, Paris, France, 537,097. Filed Oct. 23, 1893.

Claim 1.—As an improved article of manufacture, a commutator brush formed of superposed folds of metallic sheet foil compressed into a compact body.

Lamps and Appurtenances:—

Electric Arc Lamp, F. M. Lewis, London, Eng., 538,023. Filed Oct. 12, 1891.

Consists essentially in the introduction as a part of the controlling mechanism of a rocking arm connected to the plunger of the solenoid and a differential or epicyclic train of wheels in such a manner that the feed of the carbons toward each other is effected through one side of the train, while the striking or moving apart of the carbons is eff-cted from the opposite side of the train, the rocking arm controlling the former (i. e. the feed) and operating the latter (i. e. the striking).

Miscellaneous:—

Electric Appliance for Elevators, J. H. Roberts, Grand Rapids, Mich., 537,855. Filed Oct. 6, 1894.

Automatic switches for stopping the elevator at the end of its travel; also under the control of the operator for stopping at stations.

Electrical Appliance for Elevators, J. H. Roberts, Grand Rapids, Mich., 537,856. Filed Feb. 23, 1895.

A mechanism timed with the winding drum to operate the switches, for breaking the current.

Rheostat, G. H. Whittingham, Baltimore, Md., 537,876. Filed Dec. 11, 1893.

Claim 1—In a rheostat, the combination of a heat radiating casing, a resistance wire within the casing, and loose sand packed within the casing and separating the resistance wire from the casing.

Electric Door Opener, J. Schneider, Long Island City, N. Y., 538,127. Filed May 7, 1894.

Railways and Appliances:—

Electric Motor Car, W. Robinson, Boston, Mass., 537,857. Filed Apl. 12, 1889.

A method of suspending the motor on the truck.

Electric Railway, C. C. G. Wolpers, Brooklyn, N. Y., 538,005. Filed Oct. 2, 1894.

Details of construction for underground conduit.

Electric Brake, E. D. Lewis, Savona, N. Y., 538,024. Filed Dec. 7, 1894.

The main object is to hold the brakes out of operative relation against a constantly active force which, when unrestrained, will serve to apply the brakes.

Electric Motor for Railway Cars, C. E. Emery, Brooklyn, N. Y., 538,104. Filed April 19, 1894.

Uses a slow speed motor in connection with a Willis "idle" gear for transmitting motion from armature shaft to car axle.

Electric Railway System, J. M. Faulkner, Philadelphia, Pa., 538,158. Filed Jan. 12, 1895.

A closed conduit system in which the line conductor is brought in contact with the working conductor by the attraction of a magnet carried by the car.

Automatic Cut-Out System, L. L. Borradaile, Philadelphia, Pa., 538,224. Filed Feb. 5, 1895.

Claim 1.—The combination with a trolley wire, pneumatic device in communication therewith, and a current-breaking device actuated by the pneumatic device upon rupture of the trolley wire.

Switches and Cut-Outs:

Rosette or Ceiling Cut-Out, E. A. Snow, Syracuse, N. Y., 537,907. Filed Sept. 21, 1894.

Details of construction.

Electric Cut-Out, H. A. Wagner & F. Schwedtmann, St. Louis, Mo., 538,090. Filed Jan. 5, 1895.

Claim 1:—In a cut-out the combination of an outer hollow shell, a core fitting there in making closed joints therewith, a fusible wire carried in a groove in said core, electrical connections for said fusible wire, and suitable vents leading from said groove through said shell to the atmosphere.

Telephones:—

Telephone System, W. Coonan, Jersey City, N. J., 537,967. Filed Aug. 4, 1892.

The object of the invention is to provide a test in which the indication of "busy" or "free" is made by an instrument having no effect upon the subscriber's line.

LEGAL NOTES.

GENERAL ELECTRIC TAXES IN NEW YORK CITY.

Judge Russell, in the special term of the New York supreme court, has rendered a decision vacating the assessments made by the commissioners of taxes and assessments for the year 1894 upon the personal property of the General Electric Company, the Edison Electric Light Company and the Edison General Electric Company.

The commissioners assessed the personal property of the General Electric Company for the purpose of taxation for the year 1894 at $50,000,000, and subsequently, upon application of the company, reduced it to $9,776,984. The tax upon this was $163,000. The corporation counsel, however, subsequently consented that the assessment should be reduced to $8,040,600.

Judge Russell says that assuming that all the general financial operations of the company may be now carried on in Boston, still the principal office or place of business or place where the principal financial transactions of the company are carried on is in the county of Schenectady. He says that the taxing authorities of the county of Schenectady have the right to assess the value of the personal property, and that those of New York have not.

TRYING TO STOP A NEW YORK STATION AS A NUISANCE

Mr. G. Norris tried last week to have the station of the U. S. Elec. Ill. Co. in Stanton Street, New York, stopped as a nuisance. Judge Lawrence in taking the papers intimated that he did not think sufficient ground had been shown for an injunction.

G. W. LA RUE WINS A SLANDER SUIT.

The suit of George W. La Rue of this city, against Arthur B. Cumner of Boston, for $50,000, for alleged slander, was on trial last week before Judge Wallace, in the United States Circuit Court. The complaint charged that Cumner had told certain persons that "La Rue was discharged from the Crocker-Wheeler Company's employ because he was a thief, and had made collections for the company, and not turned in the money." The jury returned a verdict of $2,000 for the plaintiff.

ELECTRICITY AT THE COTTON STATES AND INTERNATIONAL EXPOSITION.

One of the great features of the Cotton States and International Exposition will be the electric fountain, authorized at a recent meeting of the Executive Committee of the Exposition Company. The fountain will be designed by Mr. Luther Stieringer, who designed the electric fountains at the World's Columbian Exposition. It is proposed to have the fountain rise from the middle of the grand basin, in front of the Machinery and Forestry buildings. From this point it will be visible all over the Exposition grounds, and the effect produced by columns of water with infinite variety of color and brilliance will be exceedingly beautiful.

The electric street railway lines of Atlanta are making very elaborate preparations to handle the immense crowds during the Exposition. The grounds will be reached by five lines, and the terminal will be in the form of a double loop of tracks, which will enable any number of cars to roll in, unload, load and roll out in the shortest possible time without delaying the cars behind them. The terminal facilities of both the electric and steam car lines will be very ample.

The Machinery Building at the coming Cotton States and International Exposition, Atlanta, Ga., will be five hundred feet in length by one hundred in width. It will have a basement eight feet in depth, through which will extend lengthwise of the building three main lines of shafting from which power can be taken off to counters and upward through the floor at any desired point. In this way all overhead belts and counters will be avoided and the one hundred-foot span of the large exhibition hall kept clear. About four thousand horse-power of engines will be shown, and an effort will be made to have these representative of the latest and standard types. These engines will be located in Machinery Hall, and a number will be directly connected to electric generators and others will drive the main shafts, from which power will be conveyed to the various points of application by belting, rope drives, electrical transmission, etc.

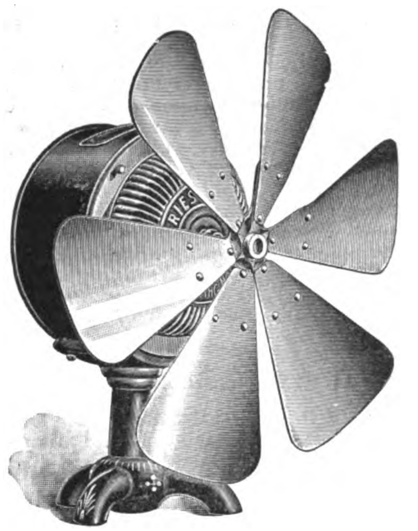
It is the intention to limit the size of any one engine to three hundred horse-power so that many of the principal builders may be represented and all have an opportunity to run under a suitable load.

The boiler house will contain five thousand horse-power of water tube boilers, consisting of ten batteries of two boilers each. The boiler-room will be equipped with all modern appliances, such as mechanical stokers, and conveyors for handling both coal and ashes. The fuel used will be bituminous.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

ROSSITER, MAC GOVERN & CO. AND THE RIES FAN MOTOR.



Ries Alternating Fan Motor.

Rossiter, Mac Govern & Co., 141 Liberty street, this city, having purchased the entire stock of fan motors of the Ries Electric Specialty Co., of Baltimore, upon the recent withdrawal of that company from active business, are now offering them to the trade at a very low figure. The Ries & Scott alternating motor is well known, and the high reputation which it has always enjoyed will doubtless ensure its ready sale. Now that hot weather is almost upon us, this is an exceptional chance to get a good machine at a very reasonable figure.

It may be noted that the Ries fan motor has its armature and field magnets built up of special laminæ in simple form which, when assembled, constitute a series of substantially closed very short magnetic circuits. The regulating and reversing devices are placed in the rear of the motor and can be handled easily while the motor is running. The motor is snugly housed yet the parts are easy to get at. The 50-volt and 100-volt motors for alternating circuits are built for a periodicity of about 133 per second.

A LOT OF SUPPLIES WANTED FOR THE WAR DEPARTMENT.

The War Department through the Sandy Hook Proving Ground, Governor's Island, New York Harbor, N. Y., Frank Heath, Captain Ordinance Department, U. S. A., Commanding, is inviting proposals until May 16th, for furnishing the following items of electric, galvanic and telegraphic material and articles:

36 carbons; 36 carbon connectors; 50 zincs; 50 zinc connectors, for carbon battery cell 6 by 8 inches, Greeley's; 100 cross arm pins; 250 feet double conductor firing cable; 30 double connectors plain; 10 De Wolsky's cells, complete for Daniell's battery; electric bells, iron frame; $\frac{1}{16}$ ohm resistance 3½ inch, triple contact; 2.5 ohms resistance, 2½ inch triple contact; 2.5 ohm resistance, 3½ inch, triple contact. 2 funnels, battery gutta percha; 4 funnels, battery glass; 6 Gassner dry cells, 7 x 3 inches in diameter; insulators, porcelain, 300 1⅛ x 1⅛ inches with screws No. 4; 100 1⅛ x ⅝ inch with screws; 500 insulators, porcelain, small spool, with screws, No. E ½, Bunnell & Co.'s catalogue; 12 jars, glass, 6 inches diameter, 8 inches deep; 12 line wire connections, small; 175 porous cups, for electric batteries, 7½ inches high, 2¾ inches diameter. Push buttons, 12 plain, No. 1; 24 metal; 25 pounds paraffin; Post, binding, Greeley's catalogue, 12 No. 2; 12 No. 1, double; 12 No. 2, double; 4 ounces resistance wire, German silver, double silk covered. Nos. 22, 26, 28 and 32; 1 pound staples, office wire, assorted sizes; 4 switches, pole changing; 24 switch pins, regular size; 2 dozen tips straight for conducting cords, 3 pounds tape, insulating, black, Grimshaw's; 1 telegrapher's pocket tool case, containing 26 tools. 50 pounds wire, office, No. 12 B. & S. gauge, 0.08 inch, paraffined and compressed; Wire copper, Brown & Sharp's gauge, 100 pounds No. 7; 100 pounds No. 14; 50 pounds No. 16; 40 pounds No. 24; Wire, copper, cotton covered, 100 pounds No. 12, double waxed and paraffined; 100 pounds No. 14 double waxed and paraffined; 300 pounds No. 20 double waxed and paraffined, white; 100 pounds No. 22, double waxed and paraffined; 200 pounds wire, iron galvanized, No. 7; 200 zincs, 1 inch diameter, 7 inches long, for De Wolski's battery; 25 zincs, for Le Clanche cells, 7 inches long, ⅜ inch diameter; 2 nippers, end cutting, 8 inches long.

OAKMAN ELECTRIC CO.

The affairs of the Oakman Electric Co. have been placed in the hands of W. D. Murray, 58 William street, New York, on assignment, for the purpose of closing up the business, which was conducted by Messrs. H. B. Oakman and H. M. Shaw, at 136 Liberty street. Mr. Shaw will continue to act as a manufacturer's agent for specialties controlled by him, and has taken offices at room 105 Electrical Exchange.

A SCHOOL ELECTRIC LIGHT PLANT FOR WEST CHESTER, PA.

The normal school trustees of West Chester, Pa. have retained William Hoopes, of Philadelphia to present plans and specifications for an electric light plant for the school.

THE HABIRSHAW INSULATION FOR HIGH TENSION CONDUCTORS.

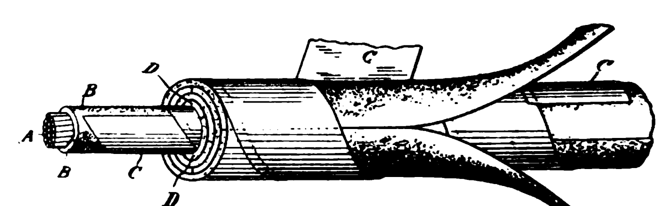
In the manufacture of rubber for insulating purposes, various kinds of materials are employed, among them what are termed "soft vulcanizable rubber" and "cut sheet" or brown rubber. The former contains from thirty-five to forty per cent. of pure Para rubber, compounded with red oxide of lead, oxide of zinc, talc and sulphur. The "cut sheet" is composed of the best Para or Bolivian rubber which has been washed, dried, formed into blocks under exceedingly heavy hydraulic pressure, subjected to a low temperature and then cut into thin sheets. The peculiar property of this material which renders it valuable for insulating purposes is its density and freedom from pores or air spaces which renders it very highly impervious to moisture.

Heretofore, cut sheet, and soft vulcanizable rubber have been used in layers in the insulating covering of cables and conductors, but the cut-sheet was applied next to the conductor, and was protected from the action of the sulphur in the soft rubber by an intermediate layer which though partially vulcanized itself by contact with the soft rubber prevented any action of the sulphur upon the cut-sheet. It resulted from this that when the conductor was heated by being overloaded, the cut sheet was softened, being reduced to the consistency of treacle in which condition it is easily perforated under high electrical pressure.

It was to avoid this difficulty that Mr. W. M. Habirshaw, the wellknown manufacturer of insulated wire, devised the method of applying these two materials in the manner illustrated in the accompanying engraving.

Around the conductor is applied a layer of soft vulcanizable rubber B. This in turn is covered by a layer of "cut sheet" C and over this is a second layer of soft vulcanizable rubber D. The insulated covering is in this manner built up of alternate layers of soft vulcanizable rubber and "cut sheet" to the required thickness, the number of such layers being in a measure arbitrary, the essential feature being that the core is surrounded by layers of soft vulcanizable rubber and cut sheet alternately disposed in the order named.

The soft vulcanizable rubber is calendered to a thickness of about one millimetre, cut in strips and then applied to the opposite sides of the core longitudinally by grooved rollers with cutting edges such as are usually employed for this purpose. Each subsequent layer of this material is applied in the same manner, the thickness of the strips and relative sizes of the rollers and core furnishing the requisite pressure for insuring perfect contact and solidity. The brown rubber is cut in strips of tapes which are stretched from six to eight times their normal length, or to practically their limit of elasticity, and wound on the ordinary taping bobbins from which they are wound spirally and so as to overlap, over the layers of soft vulcanizable rubber. After the insulating covering has been built up in this way by the desired



THE HABIRSHAW HIGH TENSION CABLE.

number of layers, it is subjected to the ordinary process of vulcanization by which means the soft rubber vulcanizes the cut sheet by contact.

Cables insulated in the manner described above have been employed by Mr. Tesla in his high tension experiments. The pressure which Mr. Nikola Tesla used on these cables was 850,000 volts, under low current density and under electrostatic conditions.

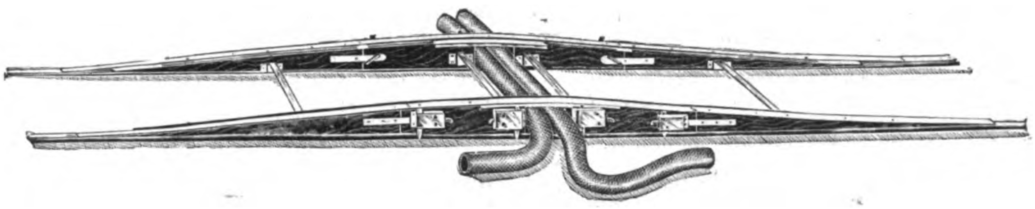
The Westinghouse Co. at Pittsburgh, tested this type of Habirshaw cable with ¼" wall of insulation, alternating pressure, and broke it down at 48,000 volts. The ⅜" and ½" wall of insulation they could not break down at 52,000 volts, although the pressure was continued for one minute. It is noteworthy that the cable was tested under water without lead covering, a point of great importance.

The Columbia Incandescent Lamp Co., of St. Louis, have recently opened an office and store room at 620 Atlantic Avenue, Boston, with Chas. E. Bibber as manager. The office will carry a large and complete stock of high grade incandescent lamps to meet the requirements of the New England trade.

FIRE HOSE CROSSINGS FOR STREET RAILWAYS.

The accompanying engraving illustrates the device manufactured by the Portable Hose Bridge Co., and handled by the Metropolitan Electric Co. of Chicago, for the protection of fire hose on street railway tracks. By means of this bridge, the interruption of traffic and upsetting of the running schedule which usually follows when a fire hose has to be laid across the track is avoided.

The parts are all of the best and heaviest materials, and will carry the heaviest motors and trailers easily. The bridge will fit any kind of rail, and it is made for any gauge. It can be placed in position by one man, and can be readily taken to the scene of a fire either in a car or a "hurry up" wagon.



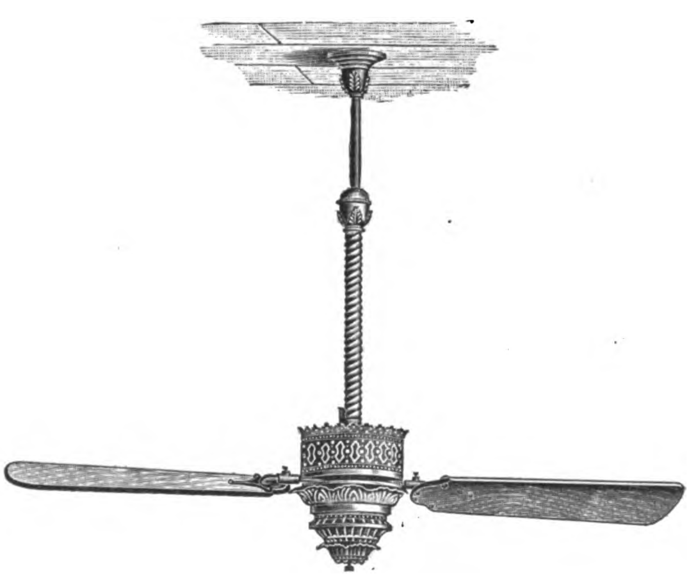
FIRE HOSE CROSSINGS FOR STREET RAILWAYS.

The bridge embodies the following points of excellence :—It is made of the best steel, and second-growth oak. It can be placed in position and used inside of three minutes, and it can be strongly and securely braced and clamped to the rail. It carries the heaviest motor cars fully loaded, and as it is but eight inches high at its centre, and sixteen feet in length, the rise of the car in passing over is almost imperceptible. It weighs 400 pounds; each side is divided into three sections, and the whole is easily carried on a car or "hurry up" wagon. Two lines of 4-inch hose can pass under each bridge. Every bridge is guaranteed for ten years.

THE MESTON ALTERNATING CURRENT CEILING FAN.

OUR engraving represents the latest type of Meston alternating current ceiling fan, which in more than one respect is a notable advance on previous work of this kind. Operating on circuits of 16,000 alternations at 52 volts, the fan blades are connected directly to the motor shaft, running at 140 revolutions per minute, and consuming the remarkably low power of 75 watts, with blades five feet in diameter and nine inches wide, and having a pitch of thirty degrees.

A distinctive feature of this ceiling fan is the fact that its speed can be regulated from maximum to zero by the aid of a regulating key ; not only that, the direction of rotation of the blades can be reversed by means of the same key, so that instead of blowing the air downward the air can be drawn upward from below, and thus the effect of a draft avoided, which frequently impairs the usefulness of ventilating devices. The new Meston alternating ceiling fan is a distinct departure and will we are sure find large application during the coming hot season. It is manufactured by the Emerson Electric Manufacturing Co., of which Mr. N. M. Garland of 112 Liberty St., New York is the Eastern agent.



MESTON ALTERNATING CURRENT CEILING FAN.

The company also manufacture an induction fan motor adapted for alternating circuits of 16,000 and 7,200 alternations per minute.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY report a large business in special Paranite cables for telephone work. They have recently delivered a large number of several hundred conductor cables of considerable length, and have a number now under way. The Paranite factory being located in the West gives the Electric Appliance Company the advantage of being able to make more prompt deliveries on special work of this kind than is possible where the goods have to come from Eastern factories. As nearly all of the new telephone plants are installed in a hurry, this matter of prompt delivery is an important item.

MR. RALPH L. SHAINWALD, President of the Standard Paint Company, was in Chicago last week attending the wedding of his brother, Mr. J. C. Shainwald, the company's western manager.

THE METROPOLITAN ARC LAMP HANGER.

The hanger shown in the accompanying illustration is designed for insulating arc lamps, when suspended out doors, exposed to the elements, where high insulation, strength and durability are required and is said to cover fully the rules of all Boards of Fire Underwriters. The ball is made of the toughest green glass, three inches in diameter, with two grooves running part way around the ball at right angles. To this are attached interlocking loops, made of seven strand galvanized steel wire, dipped in P. & B. insulating compound, thereby insuring high insulation.

To either end of the steel wire loops are fastened malleable iron castings, provided with eyes, on one of which is hung a switch hook, on which the arc lamp is suspended, thereby insuring ease of suspending and disengaging the lamp. Above the hook is a cross arm, also of malleable iron, one foot wide, on the ends of which are glass insulators for the suspension of the conductor wires to the lamps, thereby doubly insulating the lines before entering the lamp. The insulator will stand a strain of 6000 pounds, and will withstand extreme changes of weather without deterioration. It is strong and handsome, and is being put upon the market by the Metropolitan Electric Co. of Chicago.

THE METROPOLITAN ARC LAMP HANGER.

THE GENERAL ELECTRIC COMPANY'S PORCELAIN FACTORY AT SCHENECTADY, N. Y.

One of the interesting features of the growth of a great manufacturing concern is the manner in which varied and widely differing industries are included as the progress of development advances. A striking example of this evolution is furnished by the very complete factory for the manufacture of porcelain for electrical purposes, which the General Electric Company has established as an integral part of its immense establishment at Schenectady.

An especially perfect porcelain of hard, white, vitreous character, dense in structure, non-absorbent and unaffected by acids, alkalis or gases was demanded, and unavailing efforts were, it is said, made to obtain such porcelain outside. Confronted with this difficulty the company decided to build its own porcelain factory. This has now been in operation for the last three years with excellent results. It comprises mixing, moulding, drying rooms and kilns, and stands a few yards away from the eastern division of the Works, between Kruesi Avenue and the N.Y. Central Railway. It is equipped with the latest and most approved machinery, and is operated by a corps of skillful workmen under the careful supervision of an experienced man. Although only on a miniature scale, it is a complete pottery.

The building is a two-story brick structure covering a space of about 14,000 square feet. Through the roof protrude the squat chimneys of the kilns which are kept in continuous service with the constant rush orders.

Entering by the main door admission is immediately had to the mixing room where the crude kaolin or china clay which is the best for the purpose that the market can supply, is brought to be washed, manipulated and mixed. Passing from the mixing machine the clay is strained through bags to remove any material of a hard nature which might interfere with future operations. It comes from the straining press in large lumps and in that condition is partly dried, placed in a pulverizer and reduced to the necessary condition for transmission to the press room, which it reaches in the shape of a moist greyish, disintegrated clay.

The press room is immediately over the mixing room, and is well lighted and ventilated by large windows on three sides. The upright screw presses in which the porcelain is moulded stand along the three sides of the room directly under the windows. It is here that porcelain of the most intricate shapes and fashions is turned out to meet special orders. The moulds which are of special tool steel, are made in the works by a corps of efficient tool makers. Before cutting these moulds, or dies, the shrinkage of the porcelain in drying and baking is so nicely calculated that, when the porcelain in its finished state leaves the kilns, the metal parts which have been stamped out in the punch press house a few yards away fit accurately. The catalogue number of the porcelain appliance is cut in the die, and this appears in relief on the base of the finished device.

The lower part of the die is fixed to a small table, which can be moved up or down by means of a foot lever, and is set in a hollow space in the larger table forming the base of the press. The upper part of the mould is fitted to a sliding bar which is elevated and depressed by the lever and screw. The die being fixed in position, the pressman takes a portion of the pulverized clay and weighs the proper quantity in a pair of scales. With a small brush the two dies are then thoroughly dampened, the lower mould is lowered to its normal position and the operator pours in the clay which he presses evenly down with his hands to give it a preliminary packing. A vigorous twist is given to the lever and the upper die is brought down upon the clay with considerable pressure, which is increased by an additional pull at the lever. Another twist in the reverse direction, and the upper mould rises, the lower one being elevated by the foot lever at the same time. Depression of the latter lowers the lower die, and leaves the mass of clay which has assumed the form desired in the hands of the workman. The clay is then laid upon a rack to be air dried. The drying racks which occupy the entire space in the centre of the press room as well as a part of the second floor of the main building, are always full, for the press room is taxed to the utmost to keep up with the orders.

A door in the press room opens into a spacious room which occupies part of the second floor of the left wing and the whole of the main building. In this room all the pieces are corrected before they are sent to the kilns. The burrs are removed from all the holes through which screws or punchings are to pass, the marks of the dies are cut off, and the pieces put into final condition for baking. Through this room pass the upper parts of the kilns.

Descending from this clay finishing room the kiln room on the ground floor is reached. Around the four pottery kilns stand piles of yellow "hillers" and "saggers" which are made in one corner of the kiln room. Into these clay pots or pans the moulded pieces are placed. When full a cover is placed over each, and hermetically sealed. The kiln is then filled and the doors closed.

After the first baking the porcelain comes out in the form of a hard, white, compact biscuit. For certain insulating purposes, this biscuit is employed as it comes from the kilns. It is non-absorbent to a high degree, and is used for socket bases and other purposes where the porcelain is not exposed. For switch bases, insulators, cut-outs, etc., the porcelain is, however, glazed, and subjected to another firing. When it leaves the firing kiln it is as nearly perfect as the potters art can make it: beautifully white, compact in texture, extremely hard, impermeable to moisture and having exceedingly high insulating properties.

From the kilns the porcelain which is to be used in cut-outs, switches, sockets, transformer connecting boards, and in many other appliances, is taken to the second story of the right wing of the building, where the brass punchings are applied to the cut-out, the screw shells fastened to the connections, the screws set and the insulating composition applied where needed. In another part of the room are made the thousands of key and keyless sockets with porcelain bases and polished brass shells, and millions of glass fuse plugs for the plug cut-outs. At the table where the plugs are made a striking feature are the electric soldering devices, used to solder the fuse metal to the tip and exterior screw shell of the plug.

The assembling of ratchet snap switches occupies a little department by itself, as does the manufacture of the copper terminal fuses for link cut-outs. In sundry other portions of the large room other porcelain appliances of varied character are made ready.

The finished appliances are then passed on to the next room where, each neatly wrapped in tissue paper, they are packed in brown card boxes, bearing a label showing their source and giving their description.

The insulators for special work such as for transmission at very high voltages are tested in a small room adjoining. Among these may be mentioned the large double petticoat insulators for the important power transmission plant at Folsom-Sacramento. Each insulator is subjected to as severe a test as could be devised, and before being accepted as satisfactory must show its capability of withstanding a pressure of 25,000 volts alternating. In order to test the endurance of these insulators, the testing current was raised as high as 52,000 volts before any of those subjected to the test gave away.

The only trace of the enormous pressure on the outside of the insulator was a pin point hole scarcely perceptible. The General Electric Company, was one of the pioneers in the use of porcelain as the most convenient and satisfactory insulating material. Gradually electrical manufacturers came to recognize the merits of porcelain, as the electrical consumer had done already, and porcelain has come into much more general use, until to-day it is used almost universally for insulation purposes.

TESLA CURRENT TUBES.

The *Buffalo Express* of April 21, favors the public with the following, which, to say the least, is interesting, if rather mixed and confused:—"It was stated here to-night that Nikola Tesla had lately made further improvements in his method of transmitting electricity by fluid and had declared that he was more certain than ever that the current could be sent from Niagara Falls to New Orleans and Chicago and delivered there at less than it would cost to generate power on the spot by steam. The fluid he uses in the tubes costs scarcely more than water, and loses so little electricity in transit that the cost of transmission is little more than the cost of putting up the poles and tubes. It is asserted that the Niagara Falls Power Company, having at last obtained all the consents for the right of way from the Falls to Buffalo along the shore (the Grand Island route having been given up) will prepare at once to supply power for the trolley line between the two cities, and every one else along the route who will pay the price. What the price will be cannot be determined until the line for transmission has been actually completed and the loss of power in transit has been determined. If Mr. Tesla's predictions about his tubes are fulfilled, it is believed that the company will agree to the maximum price insisted upon in Buffalo." The tube method is also described as "a solution of some metallic salt contained in a metal tube surrounded by rubber."

NEW ENGLAND NOTES.

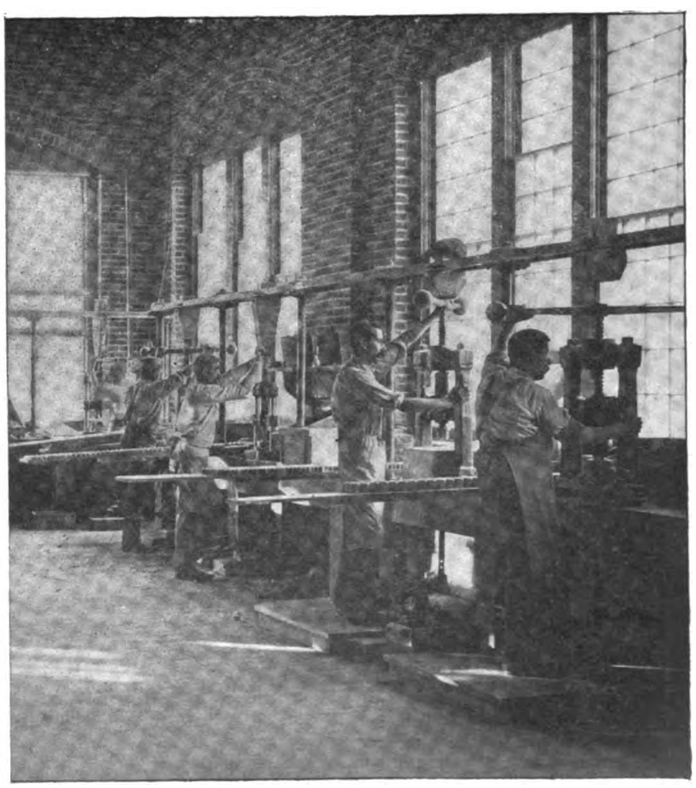
THE ELECTRIC HEAT ALARM Co., 145 High street, Boston, through its agent in St. Paul has contracted to equip the famous Ryan hotel, the largest in the city, with its system of automatic fire alarms. It will be one of the very finest equipments in the country. The company has just finished a very nice outfit, with its factory, hotel, journal bearing, and marine systems for the Continental Commerce Co., 44 Pine St., New York, and 70 Oxford street, England.

A Glimpse of the Assembling Department.

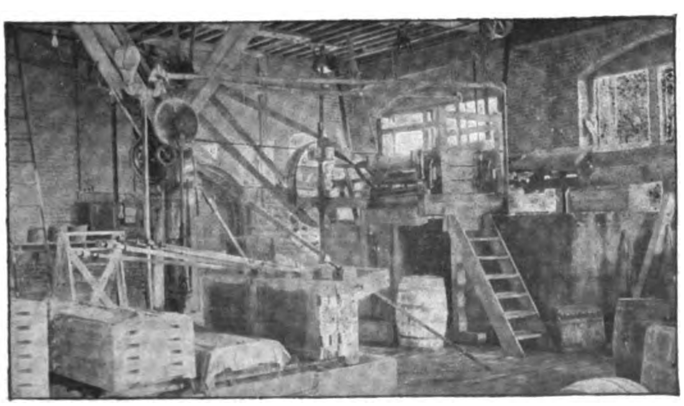
The General Electric Company's Porcelain Factory, at Schenectady, N. Y.

(See Article on Page 404.)

A View of the Kilns.



Press Room, Porcelain Factory.



The Mixing Room.

RUSSELL AND DRAKE MAST ARM.

We illustrate in the accompanying engravings the latest form of the Russell and Drake mast arm, which the Hope Electric Appliance Co., of Providence, R. I., are putting on the market. The old form of arm was made of tube, which gave very little space for the carriage which supported the arc lamp; but, as will be seen on referring to Fig. 2, the new arm is made of square

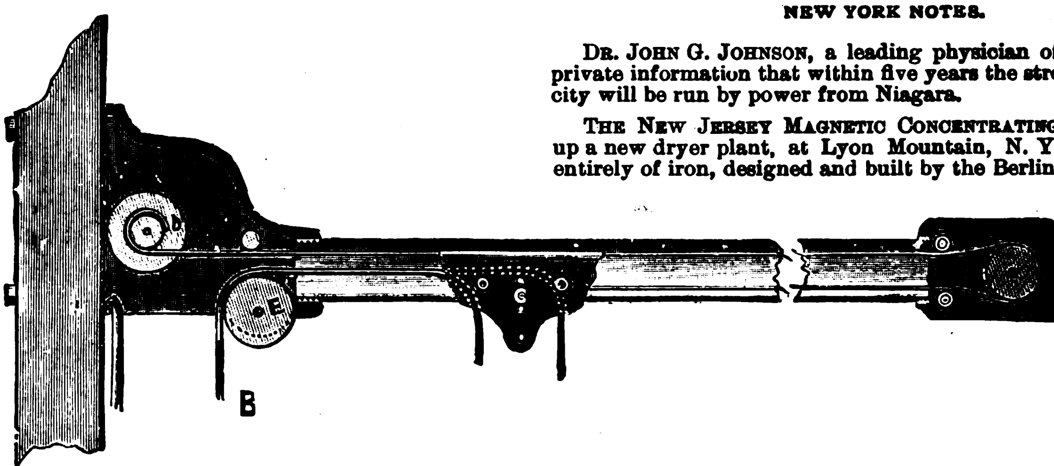
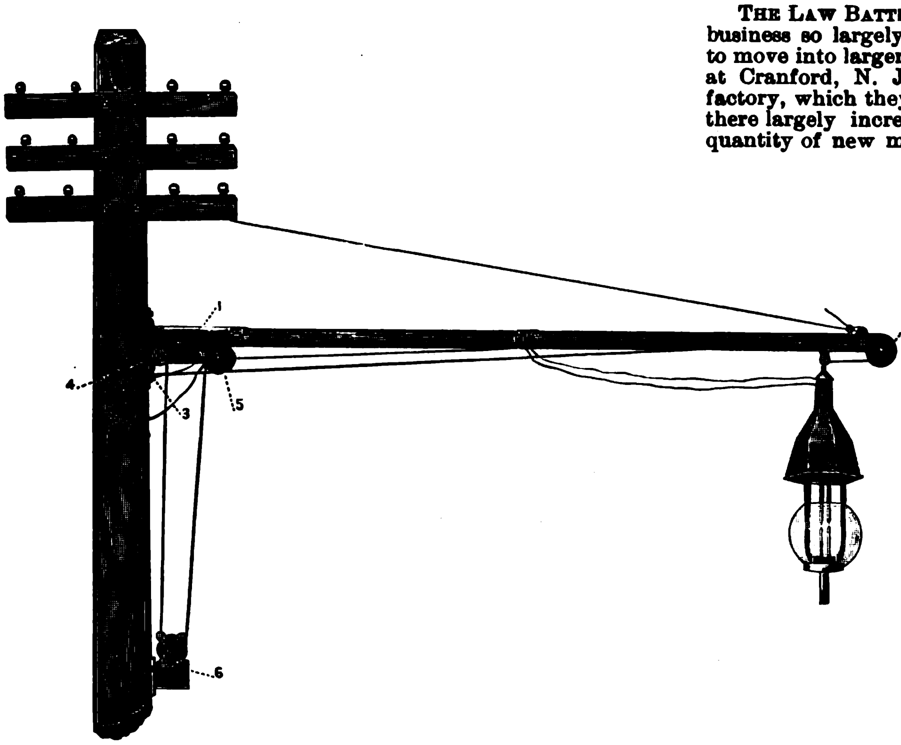
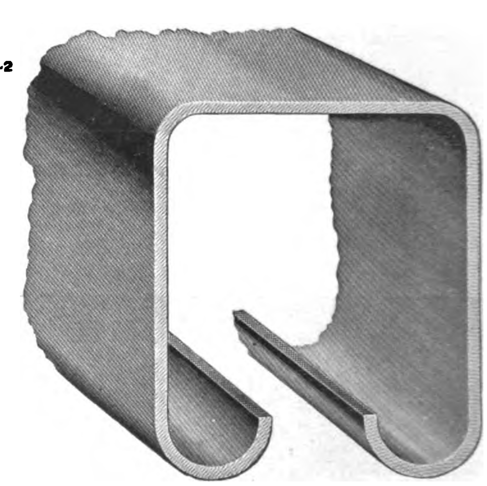


FIG. 3.—DETAILS OF MECHANISM OF RUSSELL & DRAKE MAST ARM.

section, giving ample room for the passage of a well constructed carriage, and affording thorough protection from rain, sleet, and snow. The carriage as now supplied with this arm, is fitted with four 2-inch wheels, with well designed roller bearings; the axles being case hardened and the wheels of round iron. As will be seen by reference to Fig. 1, the lamp is pulled in from its position at the end of the arm to the pole for trimming, and back, by means of an endless rope, which is so placed that the trimmer can manipulate it with the greatest ease when he reaches the proper height of the pole to trim the lamp. This does away with the





FIGS. 1 AND 2.—RUSSELL & DRAKE MAST ARM AND SECTION OF TUBE.

necessity which existed in the old lamp of climbing higher up the pole in order to operate a crank at the junction of the arm with the pole.

This device represents the most improved form of arm, in which the lamp is pulled in close to the pole for trimming. It presents many points of advantage over the previous styles of the company.

Fig. 1 shows the arm fitted to the pole ready for operation. Fig. 2 shows the square section of the tube used. Fig. 3 gives a section showing the method of operating the carriage which supports the lamp.

In addition to these mast arms, the Hope Electric Appliance Co. are placing on the market many other electrical devices, all of which are well illustrated in the new catalogue, which they have recently published.

NEW YORK NOTES.

DR. JOHN G. JOHNSON, a leading physician of Brooklyn, has private information that within five years the street cars in that city will be run by power from Niagara.

THE NEW JERSEY MAGNETIC CONCENTRATING CO. are putting up a new dryer plant, at Lyon Mountain, N. Y., which will be entirely of iron, designed and built by the Berlin Iron Bridge Co.

MR. T. H. FOOTE, consulting electrical engineer, advises us that he has removed his office to the Presbyterian Building, corner of Fifth avenue and Twentieth street.

MR. WALTER S. ANDREWS, the comptroller of the Canadian General Electric Co., Toronto, Can., is a welcome visitor to New York. He is accompanied by his family and has gone to Atlantic City for a few weeks for their benefit. As he is a very hard worker, the mild sea breezes will do no harm to his own health. Mr. Andrews will look around electrically while in this vicinity.

THE LAW BATTERY CO., of New York, have increased their business so largely within the last few years that they are forced to move into larger quarters. They have bought a tract of land at Cranford, N. J., and are just completing a handsome new factory, which they will occupy about May 1st. They will have there largely increased facilities and are equipping it with a quantity of new machinery. They will however retain a New York office, and after May 1st will be found at 39-41 Cortlandt street.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

Vol. XIX. MAY 8, 1895. No. 366.

NON-MAGNETIC ELECTRIC DEVICES.

BY

W. E. Irish

A MAN with convictions without the courage to assert them is generally considered a coward. The writer has no desire to be so stigmatized yet finds considerable difficulty in mustering the necessary boldness to make the following declaration of his belief. Having during a number of years experimented extensively with electro-thermal conductors as a substitute for electro magnets and having constructed almost every description of electrical device, instrument and machine generally operated by electro magnets by substituting therefor a metal strip affected to expansion by the passage of the current so as to obtain the same results, I have been led to the conviction that electro magnets will in the near future be found only as relics of the past in museums. As such an assertion without some sort of proof might result in my incarceration in an asylum I hasten to show in a brief and crude manner how many of the most common devices may be constructed to operate without electro-magnets.

If it is a fact that a straight wire measuring perhaps but a few inches long and offering comparatively no resistance or counter electromotive force as compared with an electro-magnet will gave the same results with fewer parts, greater simplicity and higher economy, then there should be no objection to the relegation of the electro-magnet to the antiquarian's cabinet.

These conclusions have been arrived at by very gradual steps dating as far back as 1866, with modifications of the hot wire explosive fuse to the electro-thermal motor of recent date mentioned at the end of this article.

Electro-Thermal Fuses.—These experiments commenced with the electro thermal fuse which simply consisted of a small insulated case through which was passed a short wire of very high resistance. Into this case and surrounding the wire was passed the explosive powder. On the passage of the current the wire became red hot and fired the charge.

Platinum Wire Lamps.—From the platinum wire fuses to the platinum wire lamp was but a short step. At first, there appeared to be some promise in this device although we feel assured there is none to-day.

Regulators for Steam, Hot Water, Gas and Electricity.—Experiments with the fuses and lamps led to others having for their object the controlling and regulating of the supply of steam, etc., by means of a wire heated and elongated thereby. The steam, hot water, gas or electricity heated a wire which as it expanded permitted a spring, which operated the stopcock governing the supply, to recoil and regulate the feed. As the wire A, Fig. 1, contracted, it opened the stopcock and permitted more steam, etc., to pass; and as it expanded, the spring again inclined to close the stopcock and diminish the supply.

Electrical Regulator.—The above arrangement was slightly modified to meet the electrical conditions.

It comprised a lever, Fig. 2, pivoted at one end, having a strip of metal A connected and held in tension on one side and a spring attached and held in tension on the opposite side and so that one counteracted the other. Near the free end of the lever were several contact points connected with resistance coils. When the thermal strip A was expanded by the current the spring recoiled and moved the end of the lever over the contacts and so varied the resistance.

Probably many of these devices or modifications thereof might even to-day find a place upon the market and a useful application.

Thermostats.—It was quickly seen that with very slight alteration these regulators could be transformed into excellent thermostats as represented in Fig. 3. It would be well to remember that these diagrams are simple illustrations of the principle and are not intended to represent the actual device. A in all the figures represents the thermal strip.

On the same lines damper regulators were constructed as well as furnace alarms. Similar devices were constructed for regulating the heat of incubators, etc., and when desired, to signal a dangerous fall of temperature.

Galvanometers, etc.—Figs. 4, 5 and 6 represent various forms of indicators embodying the above principle. With slight modification the same indicator may be employed for electrical or temperature readings. Fig. 4 represents a drum having flexible ends drawn outward by the tension of wires A fixed to their centres, the other ends of the wire being firmly held by adjustable screws to posts placed at right angles to the diaphragms. The open end of a graduated glass tube entered the drum through the top and passed into the liquid with which the drum was filled.

As a thermometer the liquid ran up the tube as the temperature increased and proportionate to the elongation of the wires and inward pressure of the diaphragms. As a thermostat the tube at proper intervals had wires passing through its walls to close a circuit at a given temperature. As a galvanometer or electric indicator the tube was suitably graduated the two posts forming the terminals. The current heated and expanded the wires A A and the liquid rose in the tube correspondingly. Fig. 6 represents the same device arranged for recording the readings.

Mechanical Telephones.—It was noticed that under certain conditions when a current was passed through a stretched wire the latter was set in vibration. While endeavoring to reason out the cause and further experimenting in this direction a useful application of this vibratory force suggested itself in connection with the mechanical telephone. A battery was inserted so that the circuit was completed through the lightly drawn wires and diaphragms. This was found to greatly improve the articulation and permitted the use of a very much longer line. See Fig. 7.

Thermal Recording Telephone.—The above experiments led directly to the designing of the thermal recording telephone described by the writer in 1887. The recorder consisted of the usual diaphragm which transmitted its vibrations to a hot wire loop which perforated a ribbon. The irregularly perforated ribbon passed between two rollers having elastic conducting surfaces which made contact with each other through the perfora-

tions in the ribbon. The resistance of the circuit was varied by the variations in the size of the perforations.

The receiver simply consisted of a wire stretched between the centre of a diaphragm and an adjustable screw in the end of the handle, the effect of the screw being to regulate the tension of the wire as represented in Fig. 7.

This receiver when well constructed is in every respect equal to the best magneto ear telephone.

Lightning Arresters.—Fig. 8 illustrates one form of lightning arrester. The two pair of springs are prevented from making contact with the ground studs by the tension of the thermal wires A which are in circuit with the device to be protected. In the event of lightning entering this device there are eight advantageous points offered for its escape.

Electric Bells.—By a very simple rearrangement of parts and the addition of a bell dome many electro thermal bells have been constructed. See Fig. 9.

Local Telegraph Sounder.—Maintaining the same principle but slightly changing the arrangement of parts a good local sounder may be constructed. See Fig. 10.

Telegraph Syphon Recorder.—There are not many complications to stand in the way of this instrument as represented by Fig. 11.

Morse Telegraph Recorder.—Fig. 12 represents a Morse recorder actuated by the electro thermal strip.

Ampere and Other Indicators—These electro thermal indicators are as simple and practical as any for readings within about five per cent. and they possess the advantage of indicating a direct or alternating current with equal accuracy. They run right up to the maximum point and then stop dead. Figs. 13 and 14 taken in connection with what has been previously said, are sufficient to make their operation clear.

Volt Indicators.—A good voltmeter may be constructed on exactly the same lines as the ampere meter by simply employing a longer and finer wire. They also will read on either a direct or alternating circuit.

A simple recording ammeter may be constructed as shown in Fig. 15.

Motor Regulation.—For motor regulation there is no better known means than that afforded by the electro-thermal governor which automatically regulates the brushes so as to obtain the best results and maintain the speed uniform with varying load. The thermal strip and the spring are attached to the brush regulator so as to oppose each other. The current in passing through the strip to reach the upper brush expands it in proportion to the current strength, allowing the spring to act upon the regulator and shift the position of the brushes correspondingly. See Fig. 16.

When it was desired to vary the intensity of the fields the spring and strip were arranged to vary the position of a trough containing mercury into which wires from the field coils entered. The tilting of the trough in one direction caused the mercury to flow over the contacts in succession, cutting the coils gradually out of circuit. When tilted in the other direction the mercury receded from the contacts, successively putting the coils in circuit as will be understood by reference to Fig. 17. For a rheostat the device shown in Fig. 2 can be rearranged.

Automatic Resistances. — These electro thermal devices can be used to advantage on almost every electrical circuit and appliance on the circuit. Let us assume that Fig. 18 represents one form of the device protecting the armature of a motor. The thermal strip and spring controls a lever which varies the resistance between the carbon pencils in proportion to the excess of current. With a normal current the carbons remain in contact and offer practically no resistance; but as the current increases above the normal so in proportion will the strip A expand and the spring recoil and separate the carbon points and introduce a corresponding (arc) resistance. The points will be drawn apart just as far as the E. M. F. will carry the current. When the current falls again to the normal, the carbon points will again come together, and so on. There is no limit to the number of modifications of design or to the application of these automatic resistances and automatic cut-outs. Where the formation of the arc is an objection, a dead resistance may be substituted after the manner shown in Fig. 2.

These devices may be employed in place of fusible wires with the advantage that they will continue to act and react for an indefinite time without attention or renewals.

Direct Series Arc Lamp Automatic Cut-Out and Variable Shunt.—The advantages of this exceedingly simple and effective electro thermal combination will no doubt be highly appreciated when thoroughly understood. In the first place the thermal strip gives a more perfect regulation and closer feed than an electro magnet. A new and important feature is imparted the shunt, in which no practical improvement has been made for the last twenty years. In this system, it will be seen by reference to Fig. 19, that as the resistance of the arc increases, the resistance of the shunt decreases, and therefore maintains the current of the line more constant. With this arrangement there is no burning out of shunt coils.

The automatic cut-out and the variable shunt combine to prevent the possibility of an open circuit, as the lever cannot break from the main contact without introducing the shunt, and vice versa. Should the carbons for any reason fail to feed, the shunt and lamp would be instantly and completely cut out.

Low Potential Arc Lamp Regulator.—For low potential arc lamps Fig. 20 makes an excellent regulator and prevents one lamp from robbing the others of current.

Pole and Other Cutouts.—A good automatic cutout for series lamps, etc., which could be fixed readily on the pole is a thing very much needed. Fig. 21 represents such an one.

Arc Lamps.—Several non-magnetic arc lamps designed by the writer have at various times been mentioned in these pages; the principle underlying them all is the same. Fig. 22 with the following brief description is explanatory of this principle. To one side of a lever is connected an electro thermal conductor and to the other side a spring both in tension and opposing each other as in many of the other devices. The free end of the lever when the thermal conductor is expanded engages with the clutch to raise the upper carbon and establish the arc. As the arc lengthens, its resistance increases and the current falls and the strip contracts, overcoming the tension of the spring and pulling down the lever until it releases its hold on the clutch which in turn loosens its hold upon the carbon rod and permits it to feed.

With the feed comes an increase of current, elongation of the strip and separation of the carbons. These variations are practically so small that the lamps may be said to burn almost without variation of E. M. F., current or candle power. The effect on the strip is the same whether the current is direct or alternating.

The most recently designed of these lamps feed their carbons with a screw motion which possesses many advantages over the rack or clutch mechanism. The screw motion maintains a continuous instead of an intermittent feed and maintains the current, E. M. F., etc., practically constant during the life of the carbon.

Non-Magnetic Electric Motor.—It is not claimed that this, as an electric motor, is an economical apparatus. The employment of gas in place of the current is far more economical. As, however, it is open to improvement and may form a stepping stone in the direction aimed at, a brief description may be tolerated.

In this motor the contractile force of a series of metallic strips are applied in a step-by-step manner to rotate a main

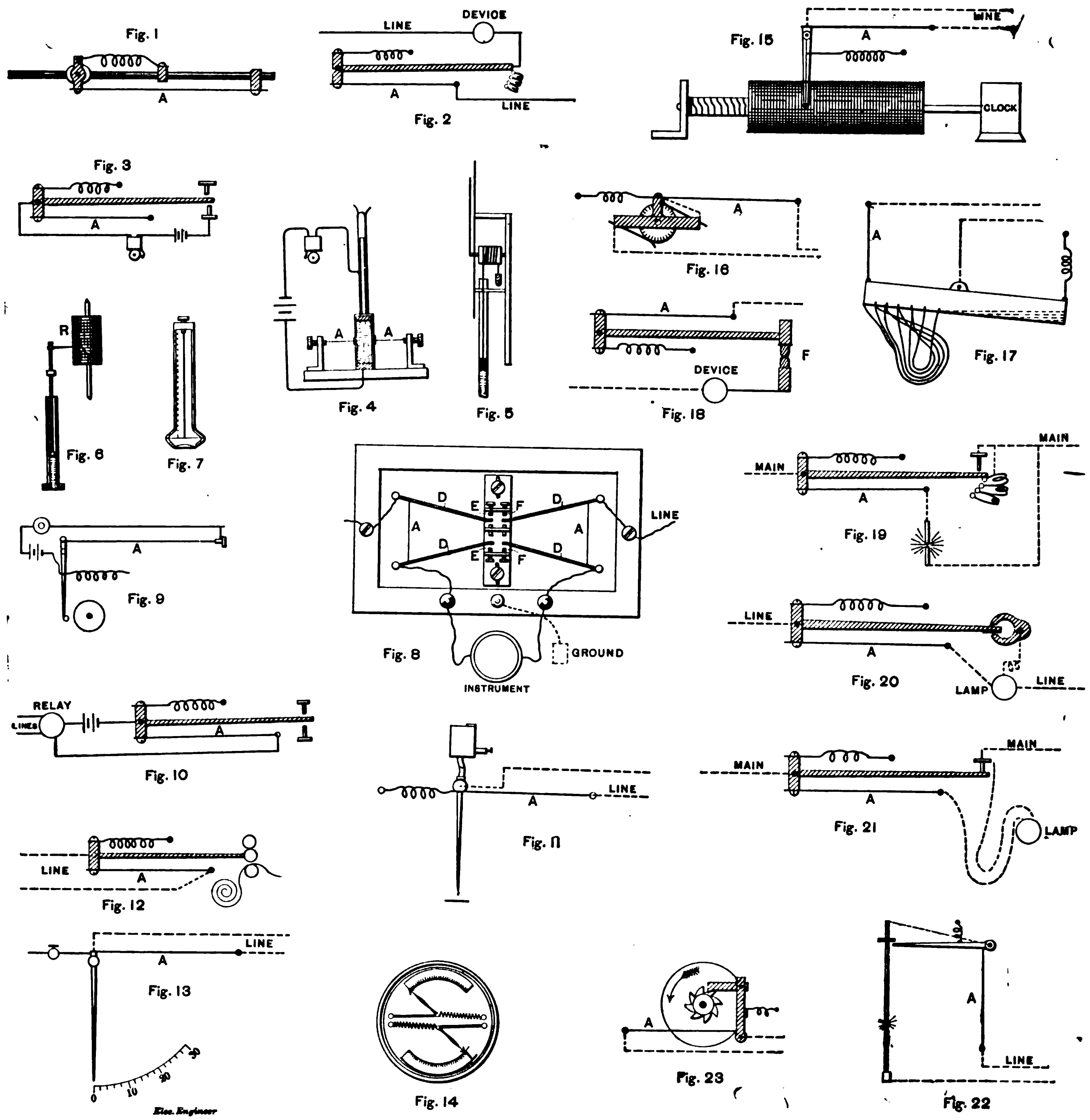
shaft which gears to the driving shaft to increase the speed. Fig. 23 represents a ratchet with a pawl engaging in one of its teeth ; the pawl is carried by the lever which is operated by the contractile properties of the strip A after being expanded by the passage of a current through it. When the strip is expanded the spring will have just enough tension to pull the lever and pawl back from the dead point so that the pawl falls over and engages in a lower tooth.

The source of heat being suddenly removed, the strip

desired. A hundred sets more or less can be arranged on the same shaft in very compact order. The driven and the driving shafts are geared into each other to meet the speed requirements of the latter.

The main shaft operates a special commutator which closes the circuit intermittently through the strips in succession, causing a continuous rotary motion of the ratchet and driving pulley.

It may not be out of place to state that a weight of ten pounds has repeatedly been lifted with the heat derived



Electrical Apparatus and Devices Operated by Thermal Wire.

contracts and the pawl pushes the ratchet and its shaft round with a force limited only by the strength of the parts acted upon. As soon as the pawl again reaches the dead point, the strip will again be expanded until the pawl engages with another lower tooth, when it will again contract, and so on.

To obtain a continuous rotary motion the number of levers, springs, thermal strips and pawls are multiplied as

from a match and that over fifty pounds was lifted through the heat derived from the combustion of about twenty inches of fine twine saturated with gasoline. It may be argued that the expansion of the strip is too sluggish for practical application to telegraph instruments, etc; so it will be with a strip too large or a current too weak. The same adjustment applies equally to the electro magnet.

A NEW FORM OF CAREY-FOSTER COMMUTATOR.

BY

W. M. Stine

Without entering into a detailed discussion of the principal types of commutators in use, it may be simply stated that the forms so far developed have shown two marked faults which can be readily overcome. The best types of this apparatus have been designed by Prof. Carhart and Mr. Elmer G. Willyoung in this country and Nalder Brothers in England[1]. Such a device as this is necessary for the comparison of standards of resistance and can be widely employed for measurement of conductivity and the temperature coefficients of metals, and measurements in general of low resistances.

A new form of this apparatus has been devised by the writer and is illustrated in the accompanying illustrations. Fig. 1 is a side view of the commutator and Figs. 2 and 3 show it in plan. Its design embodies two leading considerations: directness of all connections, with absolute freedom from liability of short circuits; that the connections might be read with ease and certainty.

The connections are made by square cast brass bars, formed as shown in Fig. 2 to receive a standard ohm on each side and to allow either standard to be shunted. The ends are brought together in parallel to make connections with the reversing table. The bars on one side make connections with the ratio coils, the battery and one pole of the galvanometer; on the other side the two bars connect directly to the ends of the slide wire bridge. All the main connections to the bars are made by mercury cups drilled in the metal. In order to reduce the temperature disturbances and to prevent the creeping of the mercury, all the metallic parts are heavily nickel plated.

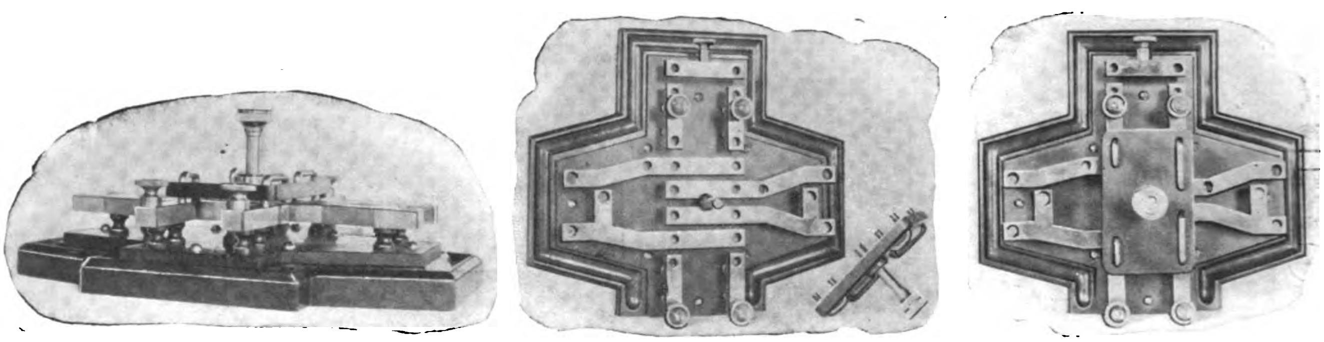
One of the principal features of the commutator is its simple reversing table. The four connectors are mounted on a piece of ebonite which is supported concentrically on a pin projecting from the base. The table is arrested in its motion by a pin detent which drops into holes placed diametrically in a guide, so that the table automatically drops into the proper mercury cups. The four table connectors are arranged in pairs, one long, the other short. This arrangement permits the direct reading of the two standards with their respective bridge ends, a point which insures accurate and rapid work.

Referring to Fig. 1 it will be seen that the bar connectors are supported on rubber bushings. These separate them $\frac{3}{8}$ of an inch from the rubber sub-base. This in turn is mounted on a wooden base which has a trough for catching mercury extending well around it. This construction prevents effectually all dangers from short circuits due to mercury globules or dust. Any mercury falling from the cups will be caught by the trough.

1. For a detailed treatment of these forms the reader is referred to a paper by the writer in *Electrical Engineering*, Chicago, Ill., May, 1894.

This piece of apparatus is one of a set of four commutators constructed in the apparatus shop of the Electrical Department of Armour Institute, for use in its laboratories. The mechanical construction was done under the supervision of the department mechanician, Mr. Alfred Weller.

Armour Institute, Chicago.



Figs. 1, 2 and 3.—A New Form of Carey-Foster Commutator.

A SIMPLE ELECTRIC CHRONOGRAPH.

Mr. Carl Barus, in the *American Journal of Science*, describes a simple chronograph pendulum which is likely to be very useful to those who have no break-circuit chronometer or seconds clock at their disposal. It is a simple mechanism by which an ordinary seconds pendulum is both kept in motion and made to record its oscillations on one or more chronographs sharply. The heavy metallic bob of the pendulum is electrically connected with the knife-edge, and its top is surmounted by a soft iron armature, which is attacted during part of the swing by an electromagnet, and thus kept in motion. A longer and very much lighter pendulum, consisting of a flat bob suspended by two wires, is suspended by the side of the first, and swings in the same plane, but with a longer period. As the heavy pendulum approaches it, it touches a platinum spring projecting from the other bob, makes current for a moment, and works the chronograph, and at the same time sends the current through the electromagnet. The contact is quite momentary, as the spring causes the wire pendulum to be hurled off ballistically. On its return it is brougnt to rest, without rebounding, by a stop, against which it leans till the seconds pendulum returns. The bob of the light pendulum is made up of two small square parallel plates, between which the wires and the platimum strip are clutched by a single central screw. A band of platinum foil is wrapped round the heavy bob, in order to ensure reliable electric contact. The chronographs and the electromagnet are connected in parallel. The records show that the time of contact does not reach 0·1sec.

TELEGRAPHING BY INDUCTION.

Among the observers who have devoted a considerable time to this problem is Mr. W. H. Preece, the chief engineer of the Telegraph Department of the Post Office. Recently the submarine cable connecting Oban with Auchnacraig broke down, and the telegraphic messages have since been passed between these two places (distant about six miles) by means of Mr. Preece's inductive method. A gutta-percha insulated wire, one and a half miles long, was laid along the ground from Morven, whilst on the Island of Mull use was made of the ordinary overhead line connecting Craignure with Aros. The distance between the two parallel wires was about $3\frac{1}{2}$ miles. Using a vibrator as transmitter, and a telephone as receiver, the usual messages were successfully dealt with.

LITERATURE.

Armature Winding of Electric Machines. By H. F. Parshall, M. A. I. E. E., M. I. E. E., and H. M. Hobart, S. B. New York, D. Van Nostrand Co., 1895. 350 pp., 129 plates. 9½ x 11 in. Price $7.50.

WE believe it will be conceded that the best works on dynamo electric machinery have appeared in the English language, and if no other evidences were forthcoming to substantiate such an assertion the fact that the standard English works on the subject have been translated into most European languages, may be considered as sufficient proof of that fact. The best of these works, discuss the subject more generally from the standpoint of the magnetic circuit, and consequently the design of the field magnets and the magnetic properties of the armature have claimed the largest share of attention. We can, of course, find no fault with this method of treatment in the works intended for the student and general practitioner, but there are many details relative to specific parts of dynamo electric machinery that these works do not go into to the extent which many have felt that they lacked. If we were to single out any particular example of the kind noted we might say that the subject of armature winding had received, perhaps, the least attention of all the minor important details in connection with the design of dynamo electric machinery at the hands of English writers on the subject, and in this respect foreign works have, up to the present, offered more. We are glad to be able to say, however, that this condition of affairs now no longer exists, and that the English reader will be soon in the possession of a work which we have no hesitancy in saying will take the first place as a standard on the subject of which it treats.

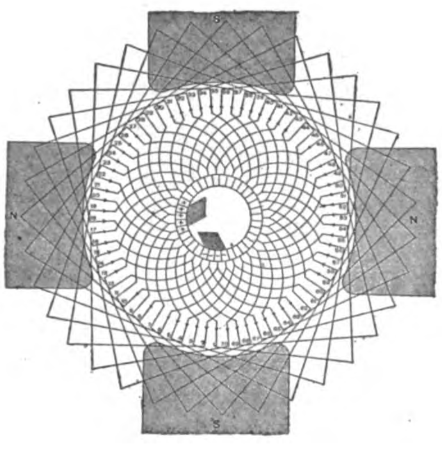
After the general magnetic design of a dynamo has been worked out there is perhaps nothing so perplexing to the designer as the selection of the proper winding for the armature, for upon it much of the success of the finished machine will depend, and the embarrassment which confronts him is perhaps increased by the very fact that the methods of winding open to him are by no means limited in number. But to place before a beginner a series of diagrams of windings pure and simple without some guide as to the types best adapted for certain conditions would be equivalent to putting to sea without a compass. In other words, it requires experience to guide him in the selection of the winding best adapted to a given machine, and it is in this that the strong point of the volume before us lies. The hundreds of windings which are illustrated are all accompanied by a more or less brief explanatory note, indicating the manner in which the winding is carried out, the advantages and disadvantages, both directly and as compared with other windings adapted for the same conditions.

The authors incline strongly to the opinion that the type of winding should be determined with reference to the magnitude of the current to be generated, and that any deviation from a perfectly symmetrical arrangement of the armature conductors should be inversely proportion to the magnitude of the current to be generated. This, we think, is a very safe principle to be followed, but a glance through the work illustrating the windings devised by various designers, shows that the rule above quoted has been honored more in the breach than in the observance.

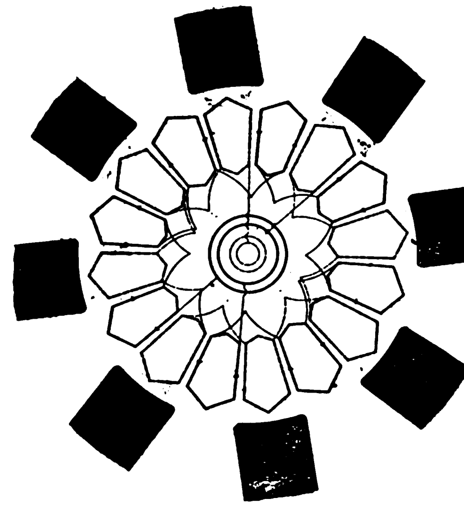
To give but the briefest possible account of the contents of the volume before us would require more space than is at our disposal. The book is divided into three parts. I. Continuous Current Armature Winding. II. Windings for Alternating Current Dynamos and Motors. III. Winding Formulæ and Tables. In Part I, we find descriptions of the single and double wound Gramme rings, single and multiple wound multipolar rings and numerous forms of drum armature windings. We believe, however, that it is in the second part of the book that the reader will be more particularly interested, in view of the rapid rise to prominence of alternating current work, more especially in the domain of power transmission. Alternating current windings offer as great field for variation, if not a greater, than do the continuous current, but require a correspondingly greater care in the selection to obtain the best results. The authors recognizing this great diversity, both in the method of application of the conductors, as well as in the type of the armature, thought it best to limit their discussion to the general assumption that the windings are laid on the periphery of a drum, either on the surface or imbedded in slots and that the necessary connections are made at the ends of the armature. They do well, we think, to point out the peculiarity of multicoil alternating windings as compared with the unicoil, dwelling upon the fact frequently overlooked that in the case of a given number of conductors arranged in a multicoil winding less terminal voltage will be obtained at no load than would be the case if they had been arranged in a unicoil winding, and that the discrepancy will be greater in proportion to the number of coils into which the conductors per pole piece are sub-divided, assuming that the spacing of the groups of conductors is uniform over the entire periphery. It is this fact which explains the falling off in voltage not infrequently met with in alternators at light loads, with other conditions, including speed, maintained constant. The reason for this, of course, is to be sought in the reaction of the machine, when loaded, which determines the voltage at the generator terminals, and hence calls for increased field excitation to maintain voltage at the generator terminals as the load comes on. Nevertheless the authors believe that the multicoil design possesses some advantages that may in many cases cause them to be preferred. The windings described include various types of single phase, quarter phase and three phase windings, the latter including both the "Y" and "Δ" connection; and the authors also discuss fully the relative voltage between collector rings and continuous current voltage at the commutator, in the case of three-phase continuous current commutating machines.

In order to give the reader some idea of the manner in which the work is illustrated we show, in the reduced engravings Figs. 1, 2 and 3, taken from the work, diagrams illustrating respectively a two-circuit triple winding for drum armatures, a quarter phase armature winding, and a three-phase winding. These engravings are reduced to nearly ½ the orginal size, those appearing in the work being nearly all of a uniform diameter of eight inches, so that all windings can be traced clearly.

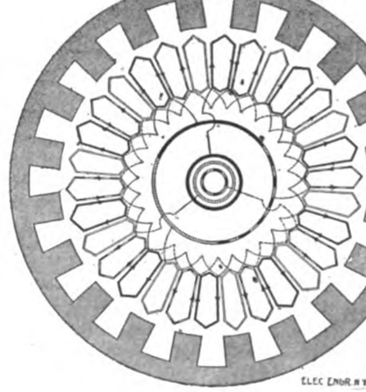
In Part III the authors give a formula for determining the electro-motive force of armatures of all types, of both continuous and alternating machines, and show their practical application by actual examples, illustrating the method of applying the formula. This is followed by armature winding tables, the nature of which we can best illustrate by referring to the accompanying Tables 1 and 2, reduced from the pages of the work. The first gives the data for applying two circuit triple winding for drum armatures, while Table 2 is one of a continuous series of tables of two circuit triple winding for drum armatures, in which the number of conductors varies between 202 and 1600, and the number of poles from four to sixteen. Similar tables are included in the work covering two circuit, single and double



2-CIRCUIT TRIPLE WINDING.



QUARTER-PHASE WINDING.



THREE-PHASE WINDING.

winding and multiple circuit single, double and triple winding.

We have said enough, we believe, to indicate the wide scope and great usefulness of the work before us. Perhaps the only

DATA FOR APPLYING TWO-CIRCUIT, DOUBLE WINDINGS FOR DRUM ARMATURES.										Volts per 100 conds per 100 R.P.M. with flux = 1 megaline	Volts between comm. slots per megaline & per 100 R.P.M. ⑤
Number of Poles	Conductors per slot										
	1	2	4	6	8	10	12	14	16		
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.667	1333
6	[illegible]	[illegible]	OO		OO	[illegible]		[illegible]	OO	2.50	800
8	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		3.33	534
10	[illegible]	[illegible]	OO	[illegible]	OO		OO	[illegible]	OO	4.17	[illegible]
12	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	5.00	1 200
14	[illegible]	[illegible]	OO	[illegible]	OO	[illegible]	OO		OO	5.83	1 636
16	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		6.67	2 14

⑤ Independent of number of Conductors.

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① Moreover, in multiple Windings this value is merely nominal, as a careful analysis of Multiple Windings shows that if the value can be approached at all, it is only by means of more careful mutual adjustment of the Brushes than is practicable with present methods.

TABLE 1

No. of Conductors	4 Poles F	4 Poles Re-entrancy	4 Poles B	6 Poles F	6 Poles Re-entrancy	6 Poles B	8 Poles F	8 Poles Re-entrancy	8 Poles B	10 Poles F	10 Poles Re-entrancy	10 Poles B	12 Poles F	12 Poles Re-entrancy	12 Poles B	14 Poles F	14 Poles Re-entrancy	14 Poles B	16 Poles F	16 Poles Re-entrancy	16 Poles B	No. of Conductors
102	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	11	ooo	13				[illegible]	[illegible]	[illegible]				5	ooo	7	102
104										11	[illegible]	11				7	[illegible]	7				104
106	[illegible]	[illegible]	[illegible]				13	[illegible]	15	9	[illegible]	11				7	[illegible]	9	7	[illegible]	7	106
108				[illegible]	[illegible]	[illegible]																108
110	[illegible]	[illegible]	[illegible]				13	[illegible]	13													110
112																						112
114	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	15	ooo	15	11	ooo	13	[illegible]	[illegible]	[illegible]							114
116										11	[illegible]	11										116
118	[illegible]	[illegible]	[illegible]				13	[illegible]	15							7	[illegible]	9	7	[illegible]	7	118
120				[illegible]	[illegible]	[illegible]										9	ooo	9				120
122	[illegible]	[illegible]	[illegible]				15	[illegible]	17										7	[illegible]	9	122
124										13	[illegible]	13										124
126	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	15	ooo	15	11	ooo	13	[illegible]	[illegible]	[illegible]							126
128																						128
130	[illegible]	[illegible]	[illegible]				17	[illegible]	17													130
132				[illegible]	[illegible]	[illegible]										9	ooo	9				132
134	[illegible]	[illegible]	[illegible]				15	[illegible]	17	13	[illegible]	15				9	[illegible]	11	7	[illegible]	9	134
136										13	[illegible]	13										136
138	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	17	ooo	19				[illegible]	[illegible]	[illegible]				9	ooo	9	138
140																						140
142	[illegible]	[illegible]	[illegible]				17	[illegible]	17													142
144				[illegible]	[illegible]	[illegible]				15	ooo	15										144
146	[illegible]	[illegible]	[illegible]				19	[illegible]	19	13	[illegible]	15				9	[illegible]	11				146
148																11	[illegible]	11				148
150	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	17	ooo	19				[illegible]	[illegible]	[illegible]				9	ooo	9	150
152																						152
154	[illegible]	[illegible]	[illegible]				19	[illegible]	21	15	[illegible]	17							9	[illegible]	11	154
156				[illegible]	[illegible]	[illegible]				15	ooo	15										156
158	[illegible]	[illegible]	[illegible]				19	[illegible]	19													158
160																11	[illegible]	11				160
162	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	21	ooo	21				[illegible]	[illegible]	[illegible]	11	ooo	13				162
164										17	[illegible]	17										164
166	[illegible]	[illegible]	[illegible]				19	[illegible]	21	15	[illegible]	17							9	[illegible]	11	166
168				[illegible]	[illegible]	[illegible]																168
170	[illegible]	[illegible]	[illegible]				21	[illegible]	23										11	[illegible]	11	170
172																						172
174	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	21	ooo	21	17	ooo	19	[illegible]	[illegible]	[illegible]	11	ooo	13				174
176										17	[illegible]	17				13	[illegible]	13				176
178	[illegible]	[illegible]	[illegible]				23	[illegible]	23													178
180				[illegible]	[illegible]	[illegible]																180
182	[illegible]	[illegible]	[illegible]				21	[illegible]	23										11	[illegible]	11	182
184										19	[illegible]	19										184
186	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	23	ooo	25	17	ooo	19	[illegible]	[illegible]	[illegible]				11	ooo	13	186
188																13	[illegible]	13				188
190	[illegible]	[illegible]	[illegible]				23	[illegible]	23							13	[illegible]	15				190
192				[illegible]	[illegible]	[illegible]																192
194	[illegible]	[illegible]	[illegible]				25	[illegible]	25	19	[illegible]	21										194
196										19	[illegible]	19										196
198	[illegible]	ooo	[illegible]	[illegible]	[illegible]	[illegible]	23	ooo	25				[illegible]	[illegible]	[illegible]				11	ooo	13	198
200																						200
	4			6			8			10			12			14			16			

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TABLE 2.

regret that we have in connection with it is born of the fact that all reference to mechanical details of construction of armature winding has been omitted. It is true these permit of great variety, without modifying the results, but the very fact that the authors have had such a varied experience would have made its recording of value to others, not only to those who are in the field but others about to enter. We can only add that the profession is under obligations, not only to the authors, who have spent much painstaking labor in the getting together of the work, but also to the publishers who have spared no expense to present it to the reader in the manner best calculated to assist him in his work.

ELECTRIC DISPERSION.

P. Drude, in *Wiedemann's Annalen*, describes a method for investigating the relation between the dielectric constant of a substance and the period of the electric waves traversing it, or what may be described as the electric dispersion of the substance. If the dielectric constant decreases as the period increases, there will be normal, if it increases, anomalous dispersion. For alcohol dispersion was found to be normal, and of the same order of magnitude as its optical dispersion. Water showed abnormal dispersion with the large wave-lengths used, whereas ebonite showed no perceptible dispersion.

KINGSTON, CAN.—A company with a capital of $50,000 has been formed for the manufacture of a new "magnetic motor," the patents of which are said to be held by a syndicate with a capital of $100,000.

SOCIETY AND CLUB NOTES.

THE NEW HOUSE FOR THE FRANKLIN INSTITUTE.

Note was made in THE ELECTRICAL ENGINEER last week of the movement started in Philadelphia to provide new headquarters for the Franklin Institute. The plan has been approved by the Board of Managers, and we now illustrate the proposed new building. This scheme proposes the erection of a 12-story fire-proof building, in a central business location. Three or four floors are to be used by the Institute, and the remainder of the building is to be rented for business offices and to kindred societies. A ground floor auditorium, with a seating capacity of 2,000, is proposed, a small lecture hall, a commodious library, offices for committees and sections, and a drawing school room.

The committee has secured an option on a suitable site, which, it is understood, is about a square and a half from the City Hall. The total cost of the ground and building, based on a detailed estimate, will be $1,500,000.

The plan for providing the necessary funds is as follows: From the members of the Board of Managers a body will be formed to be known as the Franklin Institute Building Trust. The Building Trust will take title to the lot of ground chosen and execute therefor a deed of trust to one of the city trust companies, to be held as security for all the money loaned for its purchase and for construction of the building. The Building Trust will issue

THE PROPOSED FRANKLIN INSTITUTE BUILDING.

bonds, principal and interest payable in gold, covering all the amount required to pay for the lot and to build and equip the building. These bonds will bear 4 per cent. interest, and will have 30 years to run, with the reservation that after 10 years the bonds may be called in and redeemed for the benefit of the Franklin Institute as fast as it can take them. The redemption price to be the par value of the bond with 2 per cent. premium. The Franklin Institute will contract to lease the whole building for a period of 30 years at a rental equal to the amount of the interest on the bonds and the taxes, and will also contract to keep the building in good repair. When the Franklin Institute has secured by purchase all of the bonds it will take title to the property, and the Building Trust will go out of existence.

It is estimated that the income from rents will be from $160,000 to $180,000 a year, and the expense of maintenance about $120,000, so that a sinking fund can be provided for purchasing the bonds.

THE BOSTON ELECTRICAL POTENTIALS.

The Electrical Potential Club of Boston held its annual meeting and dinner at Young's last week. Mr. C. W. Holtzer presided, and there was an informal discussion on "Alternating Currents." Mr. Holtzer was elected president and Mr. I. H. Farnham treasurer for the ensuing year. The Club maintains its quiet useful work.

THE PYLE ELECTRIC HEADLIGHT.

Mr. George C. Pyle, of Indianapolis, Ind., has completed a new form of electric headlight embodying several improvements upon that already described in THE ELECTRICAL ENGINEER. The new apparatus weighs 206 pounds and is eleven inches shorter than the apparatus now attached to locomotives. The engine for driving the dynamo is a compound steam turbine, capable of high speed. It is claimed that the only running expense is for the renewal of the carbon, which is 1¼ cents for two hundred miles. The apparatus is said to be compact and simple, there being no valves, joints, reciprocating points of wearing surfaces of any kind requiring oil, except the bearings, which run in oil. The governor is attached directly to the turbine wheel and runs without oil. The speed is two thousand revolutions. The new headlight will be manufactured in Indianapolis by the Pyle Electric Headlight Company.

SUBMARINE TELEGRAPH CABLES.—III.

BY CAPT. S. TROTT, CABLE STEAMER "MINIA."

(*Concluded.*)

After obtaining all the knowledge of the bottom necessary for our work, a distance is run from the mark-buoy to a position on one side of the line of cable, chosen according to circumstances; here a little nautical skill comes in again, which is one of the secrets of success. Having arrived at a point most suitable for the purpose, the grapnel is lowered, and when a sufficient quantity of rope is out, it is dragged along the bottom towards the line of cable, continuing the tow until it is hooked. Of course you will understand that I am describing the manner in which the work is done by the "Minia." It is very amusing to us reading about other ships crossing and recrossing the cable they were grappling for and failing to hook it, which you will see is sometimes the case by referring again to that Christmas card. When we lower a grapnel and drag it across a cable we are sure that in due course it will be hooked, and more than that, for a signal will come up from the depths of the ocean, it may be three miles or more distant, notifying us that it is hooked.

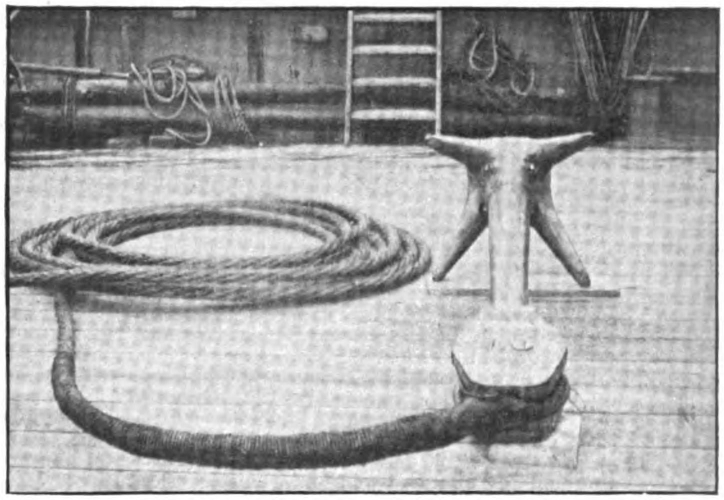
Below are three grapnels such as are used on the "Minia" in our work. One, our talking grapnel, tells us when the cable is hooked; it tells us if the cable is slipping off its prongs; it tells us also if the bottom is stony; and we also know when it gets hooked in solid rock, although the indications by dynamometer might lead one to suppose that it was the cable. The machinery used for lowering and heaving in the grappling rope and cable is very powerful, usually capable of lifting from twelve to fifteen tons; a dynamometer indicates the strain on it.

Having hooked the cable, we now heave in the rope, the ship

THE "MINIA'S" CABLE GRAPNELS.

meanwhile being kept as nearly as possible over the place where the grapnel is hooked. As the cable is being raised from the bottom it becomes tighter, and the strain on it gradually increases until a limit is reached, beyond which, if we continue heaving, it will be broken; therefore it is necessary to stop before the strain gets too high. Having previously prepared a large buoy, it is now attached to the rope and carefully lowered into the water, the grappling rope is then slipped from the ship, and the cable is now suspended by the buoy a considerable distance from the bottom. (See position B in diagram, page 414.)

The ship is again steamed into position, and a cutting grapnel is now lowered to the bottom and towed across the line of cable until it is hooked. By an electric arrangement in this grapnel also, it shows when it is in its grip, and by continuing the tow the cable is cut on the bottom (see position C); the rope and grapnel are then hove on board. We now return to our cable buoy, which is then slipped and taken on board; and having a free end of cable on one side of the grapnel, there is much less strain on the cable, so that it can now be raised with much less difficulty or danger of breaking it, and with proper caution while heaving,



AUTOMATIC ELECTRIC OR "TALKING" GRAPNEL.

it at last reaches the surface. (See position D.) Often many anxious hours are spent in this operation, every movement of the ship having to be watched, for a sudden jerk while heaving would be almost sure to break it. The rope is now secured and stoppers are put on the cable by which it is lifted from the grapnel and taken on board. A leading wire is now connected to its conductor by which the electrician will attach it to his instruments; he then calls the shore station. With almost breathless silence all wait for the welcome news "got the shore," the mental strain is relieved, an involuntary sigh of relief escapes, and frequently a hearty cheer rings through the whole ship. Sometimes the report is otherwise, and oh, what a difference! The electricians now take the usual tests, and if the cable is perfect between ship and shore, no time is lost in joining on new cable from the ship's tanks; and when the splice is completed, she steams ahead, laying whatever new cable is considered necessary. This being done, it is cut and buoyed, and after replacing mark-buoys, the ship proceeds to her new position, and in much the same manner operates for the recovery of the other end.

When the other end is recovered, if the electricians find it to be perfect to the other station, the new cable is spliced on, and the ship proceeds laying it until the cable buoy is reached; a rope is then sent away and attached to its moorings. After slipping the buoy and hoisting it on board, we heave in on the rope and take the end of cable on board; it is then again handed over to the electricians, who now take their last tests to each station. If all is in order, the final splice is proceeded with, and when finished, the bight of cable is carefully lowered into the sea, where it again finds its resting-place on the bed of the ocean. All the mark-buoys are then taken up, and the ship returns to the nearest port to learn from the stations whether or not the cable is working all right; for you must understand that, as soon as we join the two ends of the copper conductor together, we know nothing more of what may take place with the cable until we arrive.

It has more than once happened, when ships returned to port, after having been on an important repair, they have learned, to their sorrow, that the cable was not working, it having been broken unknown to them while making their final splice; in such a case the whole operation has to be repeated.

You may have noticed that so far nothing has been said about the use of boats. It is not, however, because they are not needed, for the boats and the men who man them play a very important part in the work; in fact, the lighting, unmooring and picking up of the buoys is the hardest and most dangerous part of this cable repairing business, and it is often done in very bad weather. Our sailors are dexterous boatmen, and whenever called upon for this duty, they go without hesitation, knowing that from the ship every care will be taken for their safety. We have an ironclad rule, that no boat shall be lowered at sea unless every man has his life-belt on, and in bad weather a second boat and crew is always in readiness to be lowered at a moment's notice in case

anything unforeseen should happen to the other. In this North Atlantic cable repairing the "Minia" has not only the hardest work, but she has also the worst weather to contend with; but I will venture to say, that her crew are the finest lot of men that can be found on any ship, for this work, being strong, hearty and reliable. Many of them have sailed in her longer than myself, which is now fifteen years. All this speaks well for the men and the company they serve.

Before closing this lecture I am prompted to say a little about the Anglo-American Telegraph Company, to whom the "Minia" belongs; for, I find that in this city the old pioneer company is hardly known. This may partly be explained by the fact that the Western Union Telegraph Company distributes all our traffic on this continent except in New York City, where for several years past our company has had its own offices, and partly, also, because in this company we are all so modest that we remain silent, while the officers of the opposition company are continually advertising themselves as the only people who have done anything for the public since submarine telegraphy came into existence. Here is the way they do it:

"We greet you on the completion of the first decade of our active existence. In these ten years we have accomplished much for the public."

"We have made the cable service what it never was before."

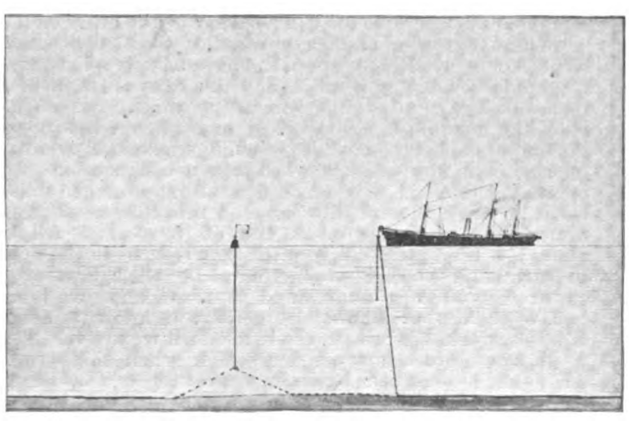
"We have laid a third line across the Atlantic."

"We have therefore made the Commercial the *speediest* and *most reliable* system between the two continents.."

There are a lot of other "We's." They might have summed them all up in the one short sentence: WE ARE THE ONLY PUBLIC BENEFACTORS!

The Anglo-American Telegraph Company, with whom an esteemed American citizen, the late Cyrus W. Field, was connected from its first inception until his death, was established to lay the 1866 cable and to take over the Atlantic Cable Company's project, their cable having been lost in deep water the previous summer. It is now a matter of history that the '66 cable was successfully laid, and that it was the first ever opened for traffic between Europe and America, and that shortly after its completion, the '65 was also recovered in mid-Atlantic, new cable spliced on, and continued into Heart's Content Harbor. Thus in one year the two great links were completed which were destined to bind together in the closest ties of peace and good will the two great English-speaking nations. Since that time our company have successfully laid not merely a third, but a seventh line across the Atlantic, the last of which has a copper conductor of 650 pounds to the nautical mile, and has probably fifty per cent. more speeed than any other cable crossing the Atlantic. I simply mention this because so much has been claimed and advertised far and wide by the opposition company, most of which, had it been in order here to-night, I would have unravelled. Many of the officers of this opposition company and most of their staff got their knowledge of submarine telegraphy in the old pioneer service, and they are among our oldest friends; we therefore regret that they should have learned so much how to pervert facts since they graduated from this truthful company.

They remind me of a little incident which occurred in my



"MINIA" LIFTING A CABLE FROM A DEPTH OF 14,400 FEET.

early cable-laying experience. It was a dark night in the winter of 1874, blowing a gale and raining heavily. We had another ship in company. I wished to give instructions to her by flashing signals. A young Russian was detailed for this service. After a little while I noticed that he kept flashing "repeat," "repeat" to the man signalling from the other ship. I lost patience, and told him that the other signals were better than his, and that I could read all that was sent. He replied, "Ah! Captain, it is ever so, the egg is more clever than the fowl who lays the egg."

And now, Mr. President and Gentlemen, from what I have told you to-night about submarine telegraphy, I think that you will see that "we" also know something about this business, and that the old pioneer, the Anglo-American Company, is still in advance of all the others.

In conclusion, I trust that although, as I said before, this subject is to me a very dry one, I hope I have succeeded in making it interesting to you. I thank you all for the very kind attention you have given me.

LETTERS TO THE EDITOR.

WHEN AND WHY LOW VOLTAGE KILLS.

Under the heading "An Unexplained Death from a 280 Volt Shock," you call for possible explanations. You can not give too much publicity to the fact that even 110 volts will kill, if applied to a bleeding sore and allowed to remain a few seconds. The fact that 110 volts does not paralyze the nerves, and that therefore the contact can most always be withdrawn at once, is the reason why we have had so few, if any, records of death occasioned by that voltage. With 280 volts in contact with a bleeding sore upon the hand, a person would be killed almost instantly. Blood being a good conductor of electricity, the current would be at once transmitted to the heart. For this reason I require all my men, operating my logging and electric canal-boat towing cableways, to wear rubber gloves, to prevent possibility of contact with a sore, although I only use 220 volts.

Mr. Nikola Tesla told the writer that 10 volts applied to a bleeding sore on the hand, would put a man to sleep.

It would be of value to humanity if your correspondent, Mr. W. J. E. Carr, would have the body of the victim exhumed, and have it examined for possible blood connection with the current.

RICHARD LAMB.

NEW YORK CITY, April 30, 1895.

A MYSTERIOUS DEATH FROM 280 VOLT CIRCUIT.

IN reply to the letter of Mr. Carr published in THE ELECTRICAL ENGINEER of April 24, I wish to venture as an explanation of the death of the operator of the electric mining machine the following:

That his person was in contact with the terminals of the machine and that in some way the circuit supplying the power was broken; or, if the machine is of the percussion type, he must have been in contact with the terminals when the current was interrupted and reversed so that in either case he would have received the effect of the current due to induction and not the effect of a current due to 280 volts.

The writer has in mind an instance where a gentleman, taking the voltage of a 100 volt machine was thrown a considerable distance by some one opening the switch in the circuit supplying the power, thus accidentally receiving the full effect of the induced current.

JOHN B. HENCH.

BALTIMORE, MD.

FRIGHT RATHER THAN SHOCK.

AFTER reading Mr. Carr's communication entitled "A Mysterious Death From a 280 Volt Shock," in your issue of April 24, I believe that the death of the unfortunate laborer was caused by fright from the shock. Some weeks ago a party of persons having no knowledge of electrical apparatus visited the writer's laboratory to experience the novelty of receiving a static discharge. A shock which was known to be harmless was administered to each, but in instances where the discharge was unexpected the persons nearly swooned from fright, while those who were expecting it made not the slightest demonstration; those so badly frightened at first received shortly afterwards a much greater discharge without exhibiting any dangerous symptoms. At another time a lady picked up a pair of carbons having a continuous difference of potential of 276 volts and after holding them long enough to say "Oh my!" she threw them down apparently unconscious of having done any injury to herself. While one might from a 280 volt circuit receive quite a startler and even become unconscious, I believe that direct electrical death would occur only when extraordinary preparation was made.

HARRY L. TYLER.

CORNING, N. Y.

WESTERN ACTIVITY IN ELECTROLYTIC WORK.

The copper refinery at Anaconda, Neb., in which the electrolytic process has been introduced, is now turning out 50 tons daily. The process has been pronounced an unqualified success. The building devoted to the manufacture cover several acres. The plant includes 600 vats. It is intended to build a refinery at Great Falls, three times the size of the Anaconda plant. The water of Black Eagle Falls is to be utilized in furnishing the current.

ELECTRIC TRANSPORTATION DEPARTMENT.

LOCK HAVEN, PA., ELECTRIC RAILWAY COMPANY. —SOME INTERESTING DETAILS.

The Lock Haven, Pa., Electric Railway has many points which recommend it to notice. The road runs from the town of Castanea, Pa., on the Beech Creek Railway through the main streets of Lock Haven, flanked closely by factories and business houses, to Flemington and on to Mill Hall, which has trebled in population within the past ten years, and is said to be growing faster than any town in Central Pennsylvania.

What makes the road of special interest at this time, when the subject of rights of trolley roads along the highways of Pennsylvania is being hotly discussed in the courts and press, is the manner in which its promoters have succeeded in securing their right of way. One of our illustrations shows the road running along the turnpike, not encroaching on it in any way but supplementing all its important functions in a very useful and vital manner. This right of way was condemned for the purpose in the usual manner, and acquired for use by payment. This solution of the highway problem was suggested recently in THE ELECTRICAL ENGINEER, and is here worked out very successfully. Another feature about this road is that while limited in various ways, and harassed by steam railway opposition, it has developed a traffic which, in view of its three miles of line, is simply enormous, and which keeps on growing.

The present car equipment consists of eight cars, two 125-ampere Westinghouse generators and switchboard apparatus, two 100-horse Phoenix engines, two 125-horse boilers, feed water heaters, pumps, and a complete steam outfit. The power-house and combined car-barn is 60 x 109 feet, built of brick with iron girders and roof, fire wall between car-barn and power-house and is a perfect fire-proof building. The car-barn is 60 x 68 feet, built of brick with iron girders and roof, containing car pits and transfer table, all equipped in the latest and most approved manner. The barn has storage for ten cars. The company owns two adjoining lots, 120 x 186 feet, which are held in reserve for extensions. The road-bed construction consists of six miles of single track, 52 pound girder rail and 60 pound tee rail, spiked direct to the ties. The very best grade of cedar and oak ties was used in the construction. All the special work was manufactured by the Pennsylvania Steel Company, and is of excellent quality. The rails are all bonded with lace bonding No. 0 copper wire, cross-bonded every third rail. The pole lines, through the city of Lock Haven, consist of 28 feet octagonal cedar sticks, butts creosoted and tarred, the upper part being well preserved by a double coating of metallic paint. That portion of the line from Lock Haven, through the town of Flemington to Mill Hall is also of the finest cedar equipped with bracket construction and carrying feed wire. In Lock Haven the overhead construction is cross-suspension

"HOME-MADE" SNOW PLOW AT LOCK HAVEN, PA.

LOCK HAVEN, PA., TROLLEY LINE ALONG TURNPIKE; PRIVATE RIGHT OF WAY OWNED BY THE RAILROAD COMPANY.

POWER HOUSE AND CAR BARN, LOCK HAVEN ELECTRIC RAILWAY CO.

work, consisting of No. 0 hard-drawn trolley and No. 0000 feeder wire. About three miles of the road, running from Lock Haven through Flemington to Mill Hall, is now in operation with two cars on thirty minute schedule.

The heavy snows of last winter found the road very busy, but unequipped with snow plows, and not anxious to invest money in plant that might stand idle a whole year after one using. The company's local staff therefore rigged up a simple but ingenious snow plow of its own, herewith illustrated. A deck of sheet iron with ends sloping to the track was mounted on a truck. The ends were kept from touching the track by means of rollers underneath, which kept the depressed end about half an inch above the rails. On the deck was mounted a hollow body to contain the shifting weight—the whole being balanced on the axle in the centre and mounted on the small truck. By shifting the weight, the plow is raised or lowered to the track as occasion may require. The plow is pushed by a motor car at a distance in front of about six feet. The superintendent of the road reports that it worked admirably, deep as the snows of the early year were.

The Lock Haven Electric Railway was chartered in February, 1894. The company have secured a franchise permitting the use of the centre of any or all streets in the city, and the right of way through the towns of Castanea, Flemington, Mill Hall, along a portion of the Lock Haven, Bellefonte and Nittaug Valley turnpike.

The officers of the company are: President, L. M. Patterson; vice-president, W. H. Mayer; secretary and general manager, H. R. Irvine; treasurer, John A. Seely.

THE EFFECT OF BICYCLES ON DENVER STREET CAR EARNINGS.

The enormous number of bicycles in use in Denver has at last compelled the Tramway company to reduce expenses to meet the great reduction in their income and the first place they began to cut was in the wages of the men. The notice was not altogether unexpected. Never since the company was fairly on its feet have the daily receipts been so low as they are at present. That the drop is caused entirely by the introduction of bicycles is beyond a doubt. During the recent stormy days when the wheels could not be used, the receipts per car, it is reported, were almost invariably over $30 per day. As soon as the streets dried off sufficiently to permit riding the cash receipts took a drop of over one-half. On the clear days, when the receipts of the company in days gone by were usually augmented by the large number of invalids and pleasure-seekers who rode about the suburbs for an outing, the receipts were, if anything, even less than expected. Instead of taking an outing on the cars, the people now ride about on wheels and the Tramway has suffered in consequence.

Estimating on the basis of 10,000 wheels in actual daily use on the streets of Denver, the cut in the receipts of the company can be easily computed. During the past year 4,000 wheels have been sold in the city alone by the local dealers, and this does not include a large number which were shipped in by individuals. At this rate the estimate of 10,000 wheels in use would be exceedingly low.

Some of the dealers claim that these wheels will average between 20 cents and 30 cents a day each from the pockets of the Tramway company, while others place the amount and the number of wheels at higher figures. But taking the low estimate of 20 cents each day for the 10,000 wheels, the amount would reach $2,000 a day, or $730,000 a year. To this should also be added the amount which was formerly received from the crowded cars which ran to suburban resorts, and which now barely take in enough on pleasant days to leave a surplus over the expenses of the crews.

TROLLEY COMPETITION WITH HACKS IN NEW HAVEN.

Official figures show a reduction this year of 50 per cent. in the number of licenses for public omnibuses, and of 30 per cent. in licenses of hacks, owing to the competition of the New Haven electric trolley roads.

A CONNECTICUT TROLLEY PARALLEL SCHEME GIVEN UP.

The New York and New Haven Railroad Company has apparently won another victory over a trolley parallel. The West Shore Electric Railroad Company, which expected to extend its line to Milford, where it would have met the system reaching eastward from Bridgeport, thus forming a line between that city and New Haven paralleling the steam road along the shore, has abandoned its enterprise and now seeks an extension only to the shore and to Woodmont station. The parallel may be undertaken at some future time, though, as the West Shore Company owns its own roadbed, it may have to do so under the impediments of the general railroad law passed many years ago, and intended to shut out parallel schemes.

THE DION RAILWAY SYSTEM AT BROCKTON, MASS.

A new "underground trolley" system called the Dion is being put on trial at Brockton, Mass., by W. H. Ames, of Easton, Mass., and others. The system is roughly described by the local journals as follows: The paving stones for a short distance between the tracks are removed in doing the experimental work, and the earth thrown out. The foundation of the work is a heavy piece of spruce, which has been treated with corrosive sublimate. This piece of board sits up edgeways, is clamped to the sleeper, and has a groove in the upper side for the reception of horse shoe shaped pieces of manganese steel. These pieces of steel are riveted together and made tight by the use of tar, and in turn are riveted to the spruce. Inside there are placed a succession of little mica chairs, upon which rests a copper rod. Fastened to this, every 20 feet, is a flexible wire ribbon, partly iron and partly copper, from which the power is to be transmitted by means of powerful magnets, to the car.

There is a flat piece of steel, of the same quality as used in the horse shoe part, placed on top and riveted. This gives a water proof inclosure for the wire. The pieces of steel at the top are five feet and three-fourths of an inch long, and at each end of the different sections the wire will be insulated. This it is thought will obviate all possible danger from coming in contact with the steel top of the inclosure which crowns up slightly above the top of the paving.

The mechanism has not yet been placed in the car which is to be used in the experiment. So far as the part that will protrude below the car is concerned it will look like a box depending from the car by means of an arm. At each end of the box will be a brush, and just inside the brushes will be some little wheels. The brushes are to keep the steel surface of the top of the wire inclosure clean, and the wheels will act much as trolley wheels do now. On the under side of the box-like arrangement, between the wheels, will be four powerful magnets. The principle is that when the magnets act upon the flexible wire ribbon, that the wire will vibrate between the copper bar and the top of the inclosure, in a wave-like motion, closing the circuit right along. As soon as the magnet arrangement leaves one of the insulated sections that one will become dead, and the current will be secured from the next one and so on indefinitely, the ribbon rising and falling in its wave like motion as the circuit closes.

COST OF THE BROOKLYN TROLLEY STRIKE.

The report of the Brooklyn Heights Railroad Company for the quarter ending March 31, which covers the period of the big trolley strike, shows a deficit of $527,010.14. The officers of the company are congratulating themselves that matters are not in a worse shape, and think that in the end the strike will prove beneficial to the company. President Lewis said:—"We will get back all the money we have lost. We are now in a position to run the affairs of the road for the best interests of the company and will do so. Before the strike we were too much bound down by the agreements with the men. There are some claims on hand against the city and we have taken no account of them in the report." It is estimated that the change in the time tables resulting from the strike will add $250,000 or more a year to the net earnings of the road.

UNPOPULARITY OF THE TROLLEY SPEED ORDINANCE IN BROOKLYN.

The Brooklyn street railway companies are not the only people who object to the new trolley speed regulations. The complaints of the citizens as to the inconvenience of reverting to the speed of the old horse cars are loud and frequent. One man is mentioned who says that in order to reach his place of business in time under the new ordinance he is compelled to leave home fifteen minutes earlier every morning, and the people are indignant that just as their slow-going city had secured up-to-date facilities of passenger traffic, it is to go back to the slow methods of twenty years ago. The following figures give the past, present, and proposed future speeds on some of the lines:

On the Tompkins Avenue line, under horses, one trip, 32 minutes; under electricity, before the present ordinance went into effect, 25 minutes; now it will be 33 minutes. Flushing Avenue line, horses, 56 minutes, electricity, in future, 60 minutes. Fulton street, horses, 54 minutes; electricity, 57; Gates Avenue to Broadway, horses, 37 minutes; electricity, 46 minutes; Broadway, horses, 48 minutes; electricity, 55 minutes.

A petition signed by the employés of the Brooklyn and Newtown Railroad Company (De Kalb and Franklin Avenue lines) protesting against the speed ordinances has been presented to the Aldermen. The petition said that the company, of which Col. John M. Partridge was the President, had voluntarily increased the wages of the men, but that the new ordinance would compel them to run a less number of trips, thus reducing their wages.

LEGAL NOTES.

TROLLEY ROADS CANNOT BE OPERATED UNDER A GENERAL PENNSYLVANIA RAILROAD CHARTER.

Another important opinion has been handed down at Morristown, Pa., by Judge Swartz in the application of the Pennsylvania Railroad Company for an injunction to restrain the Bridgeport Railroad Company from operating an electric railway on the public road, between Swedesburg and Swedeland, in Upper Marion township, on which abuts land of the Pennsylvania Railroad Company. The Court awards the injunction under the general railroad law under which steam roads receive their charter. The operation of the trolley road between Swedesburg and Swedeland ceased under the recent decision of the Supreme Court, to evade which the Bridgeport Railroad Company was, on April 6 last chartered under the General Railroad Act of 1868 to construct, maintain and operate a railroad. The Court says, "That a street passenger railway cannot be constructed and operated under the General Railroad Act of 1868 is clearly established."

AN IMPORTANT DECISION AS TO STREETS IN ILLINOIS.—PROPERTY OWNERS HAVE NO JURISDICTION OVER STREETS.

The Illinois appellate court has just handed down a decision which is of importance to all property owners in cities. Suit was brought to enjoin a street railway company from laying tracks upon certain streets, the owners of the property abutting on the streets claiming that the work would injure the value of their lots, and further setting up the claim that they had a right to decide as to what uses the street should be put to. The court holds that the property owners have no right whatever to jurisdiction over the streets; that they belong to the general public, which can make any use of them it deems proper, and that no injunction can issue.

THE FILING OF AN OPINION IN FAVOR OF THE GETTYSBURG ELECTRIC RAILWAY COMPANY.

Judge Dallas has filed an opinion in the United States Circuit Court, Philadelphia, in favor of the Gettysburg Electric Railway Company, in the dispute over the taking of land by the Government to preserve the battlefield. Judge Butler filed a dissenting opinion. The argument took place in March. The jury of seven which heard the testimony awarded the railway company $30,000 to be paid by the Government to it as damages.

Before the appointment of the jury, however, several questions of law were reserved for hearing, and they were the subject of the main portion of the argument. Last January another petition was filed by the Government, asking for the condemnation of another strip of land belonging to the trolley company, and a portion of the argument was directed to the effort of the railway company to have this petition quashed. Thomas Hart, Jr., and Charles Heebner appeared for the trolley road, and District Attorney Ellery P. Ingham for the United States.

WESTINGHOUSE SUITS AGAINST FORT WAYNE AND WAGNER COS.

Suit has been brought by the Westinghouse Company in the U. S. Circuit Court at Philadelphia, against John Mustard, for damages for infringement of the patent No. 407,295 and Reissue, No. 11,031, granted to Rankine Kennedy. These patents cover methods of secondary distribution by transformers. John Mustard, the defendant in the suit, is agent for the Wagner Electric Manufacturing Co., of St. Louis. Suit has also been brought by the Westinghouse Co. at Indianapolis against the Fort Wayne Electric Corporation for infringement of the Stanley patent No. 469,809 on System of Distribution and on the Shallenberger meter patents Nos. 388,003,–388,004 and 419,367.

EDUCATIONAL.

UNIVERSITY OF WISCONSIN ENGINEERING SCHOLARSHIPS.

For the purpose of encouraging and assisting the most meritorious students in engineering and the mechanical arts, the Regents of the University of Wisconsin have established nine engineering scholarships and seven additional competitive scholarships. Valuable features attach to these prizes, full details of which are given in a circular issued by President C. K. Adams. These scholarships will of course be open to electrical engineering students and will thus do much to encourage the study of electricity in the section of country to which the University serves as an educational centre.

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THE OLDEST ELECTRICAL JOURNAL IN AMERICA.

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CONTENTS.

VEHICULAR READJUSTMENTS.

ATTENTION has often been directed in these columns to the rapidity with which the trolley is changing the aspect of steam travel in this country and compelling in many instances the adoption of electricity, as the only means with which the old roads can meet the competition of the new parallels. Discussion, as all our readers know, is now rife as to how far this revolution or readjustment will go; and in a current magazine one of the editors of this journal has expressed the conviction, based upon data and study, that all the steam roads will ultimately become electrical. The change is working gradually, but each year sees a swifter pace and a wider sphere for the new motive power.

It is not to be supposed, however, that vehicular readjustment stops at this point. On the contrary, there is a general shifting in conditions of travel and locomotion everywhere; a new "setting to partners"; a progressive euchre of novel charm; a bumping up or down to unexpected levels as if an earthquake had shaken the strata into relationships that for some time to come can hardly be familiar but may finally endure through long periods. We know that to many of our own personal friends the success of the trolley and its access of territory bring wealth and complacency; but the trolley is still a bit of the parvenu and not quite sure of its position in society. Its own poor cousins, the conduit and the storage battery, may yet look down on it rather than up to it; and besides that, it has formidable opponents. In Denver, for example, the number of bicycles has become so enormous—10,000 wheels in daily use, it is said—that the tramway company has had to cut wages, and on fine days has to cut its schedule. If each wheel represents only 10 cents a day out of the pockets of the company, it means $1,000 a day less of gross, or $365,000 a year. No company in a town the size of Denver can sneeze at that, and hence it follows that some new readjustment is already necessary. It may be 10 cent fares; it may be a widening of the residential area; it may be that bicycles will be taxed for road maintenance. Incidentally, note may be made of the fact that in a great city such as New York or Chicago, this diminution of car revenue by the bicycle does not seem possible, for many reasons.

But while in medium sized cities, the trolley is thus preyed upon by the "bike," it also strikes deeply itself into the vitals of other vehicular industries. For instance, report comes from New Haven that, owing to the extension of the trolley, licenses for omnibuses have fallen off 50 per cent. and for hacks 30 per cent. These figures indicate an enormous remodeling of the facilities of travel, with other changes to boot. It is estimated that from first to last a trolley car relegates to idleness about 14 horses; indeed, in large cities at least a dozen horses have been the common team for each car the year around. Electricity thus means by this time the displacement of over one million horses in America, and those horses would normally require about 500,000 bushels of corn or oats a day. That represents 180 millions bushels a year less, and such a falling off would in itself account for lower prices on the grain exchanges, even if no other factors explained it. It would also mean 250,000 car loads less for the steam railroads, but this is offset by the larger haulage of coal for the power plants. Between the bicycle and the trolley, the horse is having an easy time of it, but his backers are sore perplexed.

We are sorry for the motormen of Denver with their cut wages, though motormen have struck elsewhere when nobody asked them to do it. We are sorry for the hackmen of New Haven, though it was the hackmen of Toronto, rather than the "unco' guid," who prevented the trolley cars from running in the Ontarian capital on Sundays. We are sorry for the locomotive engineers who

are losing their jobs, though they will eventually find electromotors much easier to handle than their old steeds of fire and steam. After all, these changes are inevitable and not limited to any art. Old crafts are forgotten but new ones are learned. Old fortunes are lost but new ones are made. In the long run, the world advances, and humanity is at once richer and wiser.

THE GENERAL ELECTRIC REPORT.

During the past fortnight, various figures of the General Electric report have dribbled out, but they have been viewed askance by the wary, and left rather gingerly alone. As one recalls the past, there is warrant for such caution, and at this moment the only reason to many for the premature use of certain data would appear to be the effect on the stock market. But the whole report has now been given out. It is printed in our columns this week, and can be gone over at leisure. It is very interesting, of course, although it is difficult to see why Mr. Coffin did not intone the whole production instead of having Mr. Ord deliver part of it in a kind of antiphonal response. Perhaps each puts his recitative to the part he has most faith in.

Be this as it may,—and we are not of those who are favored with backstair confidences and can speak knowingly on such family matters—the report is, taken on the whole, not half as bad as might have been expected. In many respects it is encouraging. It is pitiful, however, to find so vast a bulk of business done on so narrow a margin of profit, but we live in hopes of seeing the Company recognize the fact that others are going to do business besides itself; and then it will sell at fair, common sense margins. The public is profoundly suspicious of trade attempted on a charity basis, and wants none of it. Nothing has yet been done to carry into effect the resolution scaling down the Company's capital stock, but it is obvious that this must come, if profits remain small, for even with twice as much business, dividends would still be out of sight. Moreover, patents are still carried at over $8,000,000, when, so far as can be seen, the Company, out of its trunkful of parchments, has few fundamental patents left of any great scope, validity or length of life. The genuine courage shown elsewhere in the report, of wiping out or scaling down inflated assets, hardly appears at this point of the balance sheet.

What the report shows is that the Company, with its affiliations and its manufacturing plants, its knowledge of the business and its reorganized staff, has a magnificent earning capacity which will be more and more evident as the times improve, and which will be the larger if it devote itself to certain branches of production, and leave other concerns to specialize also. With all its enormous output, there are branches in which it cannot fairly claim to have the best product, and as long as that is the case, as it must ever be in so infinite a domain as electric light and power, the hope of control is as desperate as that which was defeated by the snows of Moscow. This fact recognized, the Company's prospects would be bright and sure, and its high place in the industry worthy the inventions it has gathered up of such men as Edison, Thomson, Van Depœle, Sprague, Henry, Rice, Steinmetz, and many another leader; worthy, no less, the large sums of money invested in it with honest purpose.

ELECTROLYSIS.

At one time it appeared as if the great bugbear, induction on the wires of neighboring companies, would prove a serious obstacle to the operation of the circuits belonging to electric light and railroad companies; but we hear little of that nowadays, and the litigation brought about has resolved itself in such a manner that the respective rights of the contending parties are now pretty well defined. In its stead, however, there has arisen another conflict, not involving so much the rights and properties of companies operating contiguous wires, but affecting more particularly other conductors and pipes buried in the ground. It is electrolysis, which constitutes the source of the present trouble. The character of the litigation which has already begun by those seeking relief from evils due to the destruction of water and other conductors, will bring out arguments pro and con very similar to those which characterized the telephone induction litigation. A most interesting article on the legal aspects of electrolysis in *Cassier's Magazine*, by Mr. Henry C. Townsend, discusses this question and cites very fully the decisions given in similar cases. Mr. Townsend believes, however, that the value of the precedents offered in the case of the telephone companies who, as a rule, were refused relief by the courts, is open to grave doubt. As he points out, the Supreme Court of United States has decided that the grant of powers and privileges by legislative authority to do certain things, does not carry with it immunity for private injuries which may result directly from the exercise of those powers and privileges. The corporate liability for annoyance, discomfort or damage is the same as that of individuals for a similar wrong. The examples he cites in support of his views would seem to bear out this contention, and hence it behooves railroad companies to minimize as much as possible the current finding its way back to the station directly through the ground. Indeed, we believe this is now so well recognized, not only as a measure of protection against possible damage to neighboring property, but as a necessity to economical working, that we shall probably hear little of it in the future. In this connection it is interesting to note another form of disturbance due to electrolysis, which has attracted attention recently in London, and which has called forth an inquiry by the Board of Trade. Several explosions having occurred in the conduits carrying bare conductors supported on insulators, investigations proved that electrolysis had caused the formation of alkaline salts on the conductor supports, and even of quantities of metallic sodium and potassium. The moisture present was sufficient to cause the production of sparks, which fired the coal gas accumulated within the conduits. While, of course, the presence of gas is the primary cause of the trouble, the committee has suggested as a remedy a change in the pattern of insulators used, recommending one having a longer insulation surface than those now employed.

A FINE NEW YORK ELECTRICAL EXHIBITION.

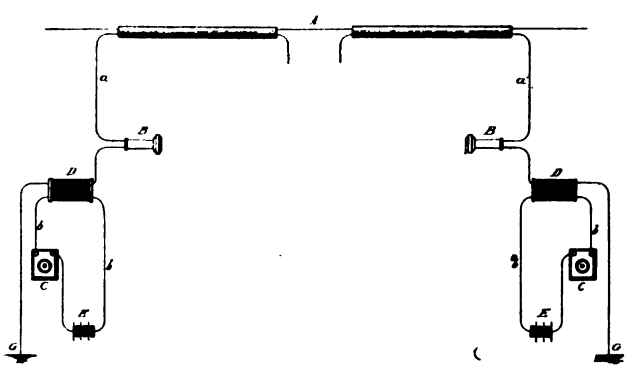
It would appear from the meeting of the National Electric Light Association's Executive Committee, that, if present ideas are carried out, New York city will have next May the finest electrical exhibition this country has seen since that held in Philadelphia in 1884. It may not perhaps be quite as large as that at the Chicago World's Fair in 1893 but it bids fair to be vastly more instructive, varied and entertaining. The times are propitious, the conditions are ripe, and there is no reason why the Association by lending its aid and countenance should not in return derive a large revenue for work it has never been able to carry out on account of lack of funds. Not only will such an exhibit bring together the largest convention ever seen of central station men, but it will add to the influence and repute of the Association, and do infinite good in informing the public as to the many ways in which current is now available for all kinds of work. But if the plan is carried out, it cannot be organized too soon, and it seems to us that steps should be taken to prolong the exhibit after the convention week. With a vigorous management, a rigid exclusion of all fakes, and a desire to give information to the public, there is no reason why the exhibition should not be a great success and confer lasting glory on the Association.

TELEPHONY.

ABSTERDAM'S OPEN CIRCUIT TELEPHONE SYSTEM.

THE theory has been held and obstinately maintained in certain quarters that for the transmission of articulate speech a closed electric circuit was an absolute essential. This theory has been vigorously controverted in the past more particularly by inventors who have designed make-and-break telephone transmitters, but so far as we are aware no one has heretofore attempted to disprove it by transferring the opening in the circuit to the line itself. Such, however, is the method adopted by Mr. John Absterdam, of New York, who in a patent just issued to him describes a system in which the line is maintained permanently open; that is to say, the line terminals are brought into such relation that while they are incapable of transmitting or transferring telegraph signals or magneto call currents they are still competent to transmit telephonically. The main advantage claimed for this system is its immunity from inductive disturbances due to neighboring conductors, whether these transmit telephonic, telegraphic, lighting or power currents.

The accompanying diagram shows the arrangement, A represents a line wire extending from one telephone station to another, and there terminating with both ends constantly open without ground connections or other connections of any kind. *a* and *a'* represent two conducting station wires located at their respective terminal stations, each extended to a suitable length adjacent to the terminal of the main line wire, but separated therefrom. The terminal portion of the main line wire and the station wire lie longitudinally near each other with their ends constantly open and so separated from one another that it is impossible to operate any telegraph apparatus or magneto current across the



THE ABSTERDAM OPEN CIRCUIT TELEPHONE SYSTEM.

space or gap between them. Each of these station wires is connected through an ordinary telephone instrument B, and thence to the secondary wire of the induction coil D, and finally continued to the earth at G. The line proper consists, it will thus be seen, of the two terminal stations' wires connected to the earth at one end, then extended alongside of, but separated from, the terminals of the line A, and having their opposite ends constantly open, the same as the open ends of the main line wire. The induction coil at each station has its primary wire *b*, connected on one side through an ordinary telephone transmitter or microphone C, and thence to one pole of a local battery E, and on the other side the primary wire is connected directly with the other pole of the battery.

The length of the portion of each terminal of the main line wire and of the station wire extended adjacent to each other, must be ascertained by actual experiment, as a greater length is required for a short telephone line than for a long line, and a shorter length is required when wires of a large diameter are used, than for wires of a small diameter.

For a telephone line situated among telegraph line wires and forty miles long or more, one and a half pounds for each wire of No. 20 B. & S. gauge, may be sufficient, which is about 269.83 feet long, per pound, and three pounds for each wire of the same gauge may be required for short telephone lines such as are used in cities. The wires are wound in the form of coils.

KINGSTON, N. Y.—To meet the competition of the West Shore Telephone Co., which is about ready to begin business in Kingston, and which proposes to charge but $30 a year for the use of its instruments, the Hudson River Telephone Co., which has been charging $50 a year, has cut the price to $25, and announces that rates will not be increased after the war is over. It is said that the West Shore company will announce a $20 rate.

THE "UNIVERSAL" TELEPHONE IN INDIANAPOLIS.

With reference to the "Universal" Telephone, illustrated in our last issue, the Indianapolis *News* says:—"The Universal Telephone Company, of this city, was incorporated to-day. The capital stock of the concern is $25,000. The directors are E. B., Charles and Robert Martindale. The company has already begun the manufacture of the Universal telephone instrument. The factory is at present on the third floor of the Talbott Block, at Pennsylvania and Market streets. The patent on the instrument was purchased by E. B. Martindale ten years ago, after he had talked from Baltimore to New York through the instrument. There was some question as to whether the instrument was not an infringement on the Bell patent, and no steps were taken to make the instrument until after the expiration of the Bell patent, early this year. The Company announces that it does not intend to operate exchanges. It will simply manufacture the instruments and sell them to companies. It is claimed for the instrument that it has points of excellence not possessed by any other instrument made. A test line has been constructed in the Talbott Block. To-day there was an exhibition of the instrument. As an illustration of what can be done, Robert Martindale sat in a chair twelve feet away from the transmitter, and his conversation, in an ordinary tone of voice, could be distinctly heard at the other end of the line. It is claimed that this is not possible with any other transmitter. The company is also manufacturing a smaller instrument, for use between residences and stables and between different parts of factories."

MUSICAL TELEPHONY IN DETROIT.

At the Detroit Electrical Works is a night watchman with a fine voice, who entertains and delights the young ladies at the telephone exchange in the evening hours, by singing to them over the wires.

MIXED MICROPHONIC METAPHORS.

An Elmira paper has, under the heading of "The N. Y. & Pa. Whale Devouring the Smaller Fish Hereabouts," a graphic picture of the telephone situation in Elmira. It says:—"The New York & Pennsylvania Telephone Company believe that the 'hello' business in this neck-o'-the-woods is theirs, and theirs they propose to maintain it, as well as the rates, if possible. Recently two new companies sprang up in Binghamton, with the avowed purpose of making it torrid for the old whale, but the mammal seems to have gotten the better of the small fry, and one of the mushroom concerns has already gone to its long rest, while the other is in the same condition as tradition tells us Mahomet's coffin was in the long ago. The promoters of the new companies in other and smaller places than Binghamton, if smaller exist, have sold out in many instances to the old reliable (when you are not in a hurry), and where they haven't sold out they have been frozen out by the old company underbidding them. So the probabilities are that we in Elmira will continue for long years yet to shout 'hello' to the exchange on State Street, and to nowhere else."

TELEPHONE NOTES.

LANCASTER, PA.—The Columbia Telephone Company, composed of several gentlemen of this place, have applied for a charter.

CEDAR RAPIDS, IA.—A new telephone company has been organized here by the Walsh brothers of Clinton, owners of the Burlington electric light, steam supply and electric railway plants, and Col. G. H. Higbee, president of the Murray iron works. The new company is making contracts at $20 a year, cutting the old company's prices in half.

GARDINER, ME.—We are informed by one of the officials of the Dirigo Telegraph & Telephone Company that the business men of Gardiner are taking hold of the company with their neighbors in Augusta, on even terms, and that all combined will push the business at once, and establish a free telephone system to include Augusta, Hallowell, Gardiner, So. Gardiner, Togus and Winthrop.

LONG ISLAND.—At a recent meeting of the Queens Co. Tel. & Tel. & S. Co. at Oyster Bay, L. I., the following officers were elected for the ensuing year: W. L. Swan, President; Dr. J. A. Faller, Vice Pres. and Secy.; E. Morgan Griffin, Treas.; U. Grant Croft, Genl. Manager. The Huntington and Oyster Bay Exchanges will be open at once and connecting line built as soon as weather permits.

NEW ORLEANS, LA.—The Standard Telephone Company has completed its New Orleans organization, which will be under the management of Capt. Harry Allen, whose district will include Louisiana, Mississippi, Alabama, Georgia and Florida. The names of the local directors are as follows: Henry Bier, A. A. Maginnis, Charles Carroll, C. J. Meyer, F. von Banastar, S. P. Walmsley, A. S. Ranlett, W. J. Behan, Carl Kohn, G. A. John, Albert Mackie, Griffith Coit, J. B. Levert, C. H. Schenck, Harry Allen.

HOOPESTON, ILL., is to have a telephone exchange.

FARGO, N. D.—Arrangements are practically completed for a telephone line to Grand Forks.

BATH, N. Y.—A telephone line is to be built from Bath, through Avoca, Cohocton and Wayland to Dansville.

GEORGETOWN, MASS.—Manager Goddard is to work up a telephone exchange in Georgetown.

FARGO, N. D.—An ordinance continues to the Northwestern Telephone Exchange Co. the right to erect poles and wires.

DELAWARE, O.—A new telephone has been organized in this city, with D. S. Fisher at the head of the enterprise.

TEXARKANA, ARK.—An ordinance has been passed granting to J. W. Davis and associates the right to establish and maintain a telephone system in the city of Texarkana, Ark.

SOMERSWORTH, N. H.—The New England Telephone & Telegraph Company has petitioned for locations for its poles and wires in this city.

ALPENA, MICH.—A citizens' telephone company is to be organized at once. It already has a large list of subscribers and promises to have a plant in running order within forty days.

CHEROKEE, IA., is installing a telephone system organized by a local company. The rental will be $2 per month for both residences and business houses.

WESTMINSTER, MD.—The Western Maryland Telephone Company have secured a number of telephone subscribers at Smallwood, Gamber, Eldersburg, Sykesville and other points.

HUNTINGTON W. VA.—The Mutual Telephone Company, a new concern has been given a franchise to do business here, and will commence to put up poles and wires in the next 60 days.

LAPORTE, IND.—The Central Union Telephone Company has announced a reduction in the price of telephones for business houses to $1 a month and fixing a rate of 67 cents for residences.

ALBANY, ORE.—A force of line-men will soon be put to work improving the Albany telephone system. Many new names will be added to the list of those using telephones.

MONTICELLO, ILL.—The Monticello Mutual Telephone Company has been formed; to establish telephones; incorporators: W. H. Plunk, H. N. Knight, N. W. Hart and others.

WHITE BEAR LAKE, MINN.—The White Bear Telephone Company has been incorporated by John C. Pratt, of Sycamore, Ill., and James L. Burns, James Berlingett, Robert Wight, Tracy Lyon, all of St. Paul. Capital, $10,000.

MASSILLON, O.—The Farmers' Telephone Company now has 184 instruments connected with the exchange. The Central Union people are also working hard, and have about 250 instruments connected.

HARFORD, PA.—At the annual meeting of the Harford Telephone Company the following directors were elected: W. B. Guile, F. A. Osborn, E. E. Jones, D. B. Thatcher, E. J. Whitney, A. T. Sweet, G. L. Payne.

AUBURN, NEB.—The citizens of Auburn have organized and incorporated a local telephone exchange company with an authorized capital of $5,000, $2,000 of which is paid up. They elected as a board of directors James W. Kerns, Thomas W. Eustice, George W. Cornell, Church Howe and John S. Stull.

WINNSBORO, S. C.—A commission for a charter has been issued to the Winnsboro & Ridgeway Telephone Co. with the following corporators: W. D. Douglas, Jas. Q. Davis, E. C. Heins and M. W. Doty. The company will construct a line twelve miles in length.

BATAVIA, N. Y.—The Bell Telephone Company from April 1 has given Batavians residence phones for $2 a month reduced from $3, business places on party lines $2.50 a month instead of $4—and it is said these reductions prevail throughout Western New York excepting in Buffalo and Rochester.

NEW BRITAIN, CONN.—The stockholders of the new telephone company have held their first meeting. The following were appointed a committee to nominate officers and prepare by-laws: R. L. Andrews, Richard Shrey, Samuel Bassett, Ira E. Hicks and Frank H. Johnson.

MONROVIA, CAL.—C. P. Dorland has applied to the Board of Trustees of the city of Monrovia for the franchise and privilege of erecting and laying telegraph and telephone wires by means of poles and wires, in and through, along, over and upon all the streets, alleys and public places of the city of Monrovia, for lighting, heating and power purposes and such other uses and purposes as are needful for the utilizing of electrical power. It is proposed by the Board of Trustees of the city of Monrovia to grant such franchise and privilege to the highest bidder for cash, and bids will be received up to May 18, 1895.

RACINE, WIS.—A movement is on foot to secure the Cushman telephone in Racine.

BELLEFONTAINE, O., is to have a new telephone exchange with reduced rates.

VICKSBURG, MICH.—The Southern Michigan Telephone Company are negotiating to put a telephone exchange in here.

LEAVENWORTH, KAN.—Mr. G. W. Beers has been granted a franchise to put in a telephone exchange at Leavenworth, Kan.

BOONE, IA.—The Boone County Telephone Co., which was granted a franchise by the city council expects to get right at the work of putting in its plant.

LAS CRUCES, N. M.—A telephone line is being constructed between Las Cruces and El Paso, for general commercial use, but more particularly to accommodate fruit buyers and sellers.

THE AUTOMATIC TELEPHONE COMPANY of Wisconsin has been incorporated at Chicago by J. H. Theobald, Wm. T. Whipple and M. Rosenfeld.

LA CROSSE, WIS.—A La Crosse telephone company which began soliciting recently reports 250 subscribers under contract for three years, and nine-tenths of them present patrons of the Bell Telephone Company.

GARDINER, ME.—The New England Bell Telephone Co., which has a telephone exchange in this city, and the Dirigo Co., of Augusta, which has an exchange at Augusta, have petitioned the municipal officers for permission to place their poles in the streets of Gardiner.

BROOKLINE, MASS.—A petition has been presented by the New England Telegraph and Telephone Company to the Brookline Selectmen for permission to extend its system of underground conduits for the conveyance of the wires which it runs through the town in furnishing telephone service.

DECATUR, Ill.—The proposed belt line telephone system of Decatur and vicinity will cost about $10,000. The line they propose to erect will go from Decatur to Mt. Zion, to Hervey City to Lovington, to Sullivan, to Bethany and to Dalton City. All are now without telephone service.

OSHKOSH, WIS.—Mayor Oelrichs of Oshkosh has signed the Home telephone franchise. This franchise was secured in the interests of the Northwestern Telephone and Electric company of Milwaukee, which will construct the exchange for a local company of capitalists.

CARBONDALE, PA.—The citizens of Carbondale, Pa., are about to organize a company for the establishment of a telephone exchange. Parties who are prepared to furnish a complete and reliable system can obtain further information upon application to A. P. Trautwein, Secretary of the Board of Trade.

CLARKSVILLE, TENN.—A telephone war is on in this city since the advent of two companies, the Clarksville Telephone Company and the Cumberland Telephone & Telegraph Company. Both companies are at work on their plants, the Cumberland putting in improvements and the Clarksville building its plant. Telephone users are to reap the benefit of greatly reduced rates for service.

TAMPA, FLA.—The Citizens' Telephone Company expects to have its line in operation within ninety day. It now has more than two hundred subscribers, but counts on fifty more. Its officers are: S. J. Drawdy, president; A. C. Clews, vice president; John Trice, treasurer; C. H. Keller, secretary and manager. The company is capitalized at $12,000, with shares at $25 each.

BRIDGEPORT, CONN.—There is now before the legislature a resolution for the incorporation of a telephone company to be known as the Peoples' Telephone Co. Ex-Gov. T. M. Waller, J. E. Bowles, J. Irving and J. J. Lawton are named as incorporators, with capital not exceeding $500,000, the place of business to be in this city.

FARMINGTON, ME.—The action of the New England Bell Telephone Company in putting in a metallic circuit from Farmington to Livermore Falls gives Farmington a through metallic circuit to Lewiston and Boston. An enterprising rival of the Bell Telephone Company is arranging to give Farmington a great extension of telephone service, both locally and with outside towns.

DURHAM, N. C.—The Interstate Telephone and Telegraph Co. (chartered under Maryland laws) has been organized with L. A. Carr, president; Dr. Fahrney, of Frederick, Md., vice-president; J. S. Carr, secretary-treasurer, and Edgar L. Miller, of Frederick, Md., general manager. The company will manufacture telephones and construct systems; capital stock, $100,000.

CLINTON, TENN.—The Clinton Telephone Company has been organized with the following officers: Dr. R. K. Medaris, president and general manager; J. C. Strader, vice president and W. W. Medaris, secretary and treasurer. The company takes charge of the exchange which has been in operation for the past year and will extend the system to the adjoining towns.

REPORTS OF COMPANIES.

THIRD ANNUAL REPORT OF THE GENERAL ELECTRIC CO.—FULL REPORT, BALANCE SHEET AND ANALYSIS.

For the sake of greater clearness, the following report has been divided into two sections, showing:

1st. The result of liquidating the assets which appeared on the Company's books prior to January 31, 1894.

2d. The result of the business of the fiscal year ending January 31, 1895.

As previously reported, the profit and loss statement showed on January 31, 1894, a debit balance of	$12,454,967 42
The result of liquidating and providing for loss on the old assets, as explained below, has increased this by	2,754,392 27
Making the total loss on old accounts (prior to 1894) as now ascertained or estimated	$15,209,359 69
The business of the year 1894 has yielded a net profit (over interest on debentures) of	414,642 72
Leaving the present debit balance of profit and loss	$14,794,716 97

Liquidation of Old Business.—In the last annual report your Directors sought to exhibit the extent to which your Company had suffered from the panic of 1893, and from other causes inherent in some of the enterprises in which it became interested at the time of its organization. Mention was made of the fact that the Accounts Receivable included $2,531,609.88 due by the Fort Wayne and Northwest Companies and other allied interests. Contrary to the expectation of your Directors, and the statements of persons directly interested in the Northwest Company, your claim as a creditor of that Company now proves to be without value; and certain other interests inherited by your Company through the Northwest Company are also valueless. The aggregate loss from these sources is about $945,000 (viz., $456,484.43 on the account owned, and about $489,000 on other items), and this sum is included in the charges to Profit and Loss in the Supplementary Statement for the year 1893 attached hereto.

During the past year the Fort Wayne Electric Company, a former ally of one of your constituent companies, has gone into the hands of Receivers, and its affairs are now being liquidated by the Court. Your Company has filed with the Receivers its claim for $1,137,555.48.

The balance sheet, and the schedules accompanying it, show the outstanding interests of your Company as stockholder in manufacturing and other companies. Many of these securities will be sold as opportunity offers. Such a course will, in some instances, involve considerable shrinkage from former book values.

There exist also several unsettled contracts antedating the formation of your Company, but which your Company has to recognize, and which will cost, perhaps, $500,000 to settle.

To cover the estimated loss on all the matters above mentioned, your Directors have arbitrarily charged $2,000,000 to Profit and Loss account, and the results, as shown at the head of this report, are after making this deduction.

Business of the Fiscal Year, Ending January 31, 1895.—Notwithstanding the adverse conditions of the past year, the output of your various factories at cost value was only slightly below that of the previous year. The output in the amount of material was considerably in excess of the previous year.

Special attention has been given to the supervision of credits, economy of administration, and the improvement of factory facilities, and your Directors and Officers have sought to adopt every device calculated to increase the efficiency of manufacture and to reduce the cost of the manufactured product. In this they have been in a marked degree successful, and great credit is due those officers and employees of your Company directly in charge of manufacturing details.

In the last annual report mention was made of the shrinkage in inventory values of electrical machinery arising from new inventions and improvements, whereby types of machinery which have been the best of their kind are often rendered obsolete. It is impossible to guard wholly against loss from this source, inasmuch as it is essential for your Company to keep on hand at all times a considerable stock of manufactured goods. Such stock has been greatly reduced in the past year, and it will be the policy of your Board to keep it down to the lowest point consistent with prompt filling of orders. This, together with the work accomplished in developing standard types of apparatus and supplies, warrants belief that the loss from this source will be diminished in the future.

In the last report your Directors expressed the opinion that they could, out of the then unliquidated assets, pay off the balance of your floating debt and also provide all necessary working capital. These expectations have been realized, and in addition thereto the Company has purchased and cancelled $1,250,000 of its own Debentures at an average cost of less than 89 per cent.

As will be seen by the statement of Profit and Loss herewith, the business of the year just closed amounted to		$13,263,611 58
The cost of goods sold, legal and general expenses and taxes were		11,451,863 98
Leaving a gross profit of		$1,811,747 60
Against which is charged interest on Debentures outstanding		464,583 33
Leaving (over interest on debentures)		$1,347,164 27
There are further charged off:		
Various old losses which are difficult of division between 1894 and earlier years, and are, therefore, all charged against the year ending January 31, 1895	$443,023 96	
Cost of all patents and franchises acquired or settled for during the year	162,298 11	
Depreciation of inventories	288,401 14	
Sundry losses	38,798 34	
		932,521 55
Leaving a net profit of		$414,642 72

Expiration of the Incandescent Lamp Patent.—As a result of the decision in the "Bate case," recently announced by the Supreme Court of the United States, it is now settled that the fundamental patent upon the Edison Incandescent Lamp expired in November, 1894. Your Company still owns patents of more or less importance upon the incandescent lamp, but it will chiefly rely upon the high quality of the lamp manufactured by it and its facilities for manufacturing in large quantities at a low cost to maintain its commanding position in the lamp business irrespective of patent control. Lamp prices have necessarily been greatly reduced. While the volume of this important part of your business will without doubt be largely increased in the future, the percentage of profit thereon will necessarily be less than heretofore.

Patent Litigation.—During the year, the Company has been successful in a number of suits in which it has been attacked by the owners of patents which it was charged with infringing. It has been defeated in no such suit. A valuable patent on the Edison form of socket has been sustained by a Court of Appeals. Several important suits on railway patents owned by the Company are in progress, some of which will be argued this spring.

Engineering Department.—The work done by the Engineering Department during the past year deserves special mention. Much has been accomplished in the development of large units, as well as in the perfection of the minor details of manufacture. The only successful work yet accomplished in the operation of elevated roads by electricity has been done by your Company, and it is now engaged in important installations of underground electric conduits for street railways. In large power generators, in mining and power transmission work, in regulating and measuring devices, and in railway motors, the development and perfection of design have been especially noticeable.

Selling Department.—The selling organization has been conducted on an efficient and economical basis, and the sales made during the past year have been almost wholly on a cash basis; the average terms of payment on all sales being 40 days after shipment.

Licensee Companies.—These companies contribute an important part of the business done by your company in Central Station lighting and distribution of power, and their growth and prosperity are closely identified with the welfare of your own Company. The relations which have heretofore existed between these Licensee Companies and your Company continue, and the policy of your company in the future, as in the past, will be to cultivate their business and coöperate in the development of such licensees.

Reduction of Capital Stock.—At the last annual meeting the following vote was passed:

"*Resolved*, That the matter of reducing the capital stock of the Company in the manner prescribed by law be referred to the incoming Board of Directors, with request that they give it attention; and, if such a course commends itself to them, that they

call a special meeting of the stockholders for consideration and proper action."

Your Board, after careful consideration, has deemed it inexpedient to take any action with reference thereto.

Future Business.—The indications are favorable for a volume of business in excess of that of last year; but prices are abnormally low, and satisfactory results will largely depend upon the ability of your Company still further to reduce the cost of production and distribution of its manufactures.

Patents.—The $8,159,264.01 at which patents are carried is the amount at which their value was taken on pages 8 and 9 of the first annual report of your Company.

The attention of stockholders is called to the accompanying Balance Sheet and Statements of Profit and Loss.

Attached hereto will be also found the report of the Second Vice-President, explaining in detail the items on the Balance Sheet and the relation of profit and loss to the business of the current and previous years, and the stockholders are referred to same for details as to these matters.

In closing this report, the President and Directors desire to express their thanks for the good work done by the officers and employees of the Company in their efficient administration of the various departments.

C. A. COFFIN, *President.*

SCHENECTADY, N. Y., May 1, 1895.

C. A. COFFIN, ESQ., *President.*

Sir:

I submit herewith:

(1) *Consolidated Balance Sheet.*—It includes the assets and liabilities of the Edison General Electric, Edison Electric Light, and the Thomson-Houston Electric Companies, which, for convenience of book-keeping only, are consolidated with those of the General Electric Company. The assets and liabilities of the Thomson-Houston International Electric and the Pennsylvania General Electric Companies were taken over by the General Electric Company during the past year and are also included in this Balance Sheet.

(2) *Consolidated Statement of Profit and Loss.*—It includes the Profit and Loss accounts of all the companies above mentioned.

Explanation of the items is as follows:

Assets, Patents and Franchises.—This account remains at the amount shown in the last two annual reports. It represents, as stated in those reports, the cost to the General Electric Company of the Edison and Thomson-Houston patents and contract rights, and its interest in the patents of the various Thomson-Houston sub-companies. During the year, $94,917.11 was expended in purchasing and taking out new patents, and $67,881 in acquiring the territorial licenses which the Thomson-Houston Company had granted to the Thomson-Houston International Electric and the Thomson-Houston Electric Light Companies, the latter being the predecessor of the Pennsylvania General Electric Company. These amounts, as well as all expenses of patent litigation for the year, have been written off to Profit and Loss.

Manufacturing Plants.—This account represents the real estate, buildings, machinery, tools, etc., at Schenectady, Lynn and Harrison. Their book value at January 31, 1894, was $3,941,128.98. During the year, $61,124.84 was expended for new buildings and $268,079.73 for new machinery. On the other hand, $370,333.05 has been written off to Profit and Loss as an allowance for depreciation, leaving the present book cost of these plants $3,900,000, or $41,128.98 less than at January 31, 1894.

Real Estate.—This account has been increased during the year $100,098.19, chiefly by taking real estate mortgaged to secure old accounts in settlement of those accounts.

Stocks and Bonds.—Lists of these securities are annexed hereto in Schedules A and B. Those having a market value have been taken at book values slightly under the price of recent sales. Where there is no established price it has been necessary to estimate their value from financial statements submitted by officers of the respective companies. Effort has been made to keep the book values of stocks and bonds of "local companies" down to present cash values.

There are stocks and bonds of various companies amounting to $3,500,000 at par, but of so speculative a character that they are carried at a total book value of only $82, being one dollar for each lot. Some of these latter are practically worthless, but others possess some merit and their aggregate value is likely to be considerable.

Notes and Accounts Receivable.—This account represents what is believed to be a conservative value of notes and open accounts of customers, after deducting and charging off to Profit and Loss old notes and accounts receivable of 466 debtors, not now dealt with except on a C. O. D. basis, amounting to $2,291,844.48, heretofore carried at $234,973.69, but no longer carried as assets, except for the aggregate sum of $466, being one dollar for each debtor. They will be liquidated as speedily as possible.

Inventories.—This account represents raw materials, goods manufactured and in process of manufacture at the Works and manufactured goods on consignment and at Sales Offices, all at factory cost. They have been inventoried item by item.

Reductions from the sum at which they were previously carried have been made and charged to Profit and Loss. The continued writing down of manufactured goods is with the intent that only standard salable apparatus shall be considered an asset.

Work in Progress.—This account represents the amount expended on installations in progress, without any credit for the profit to be derived from such installations when completed and billed.

Liabilities. Capital Stock.—To acquire five shares of Common and four shares of Preferred Stock of the Thomson-Houston Electric Co., which had not been exchanged at the date of the last annual report, three shares of Common and one share of Preferred Stock of this Company have been issued during the year.

Indebtedness.—Pursuant to the policy announced in the last annual report, various stocks and bonds, which it was not desirable for the Company to hold permanently, have been marketed. Their proceeds were placed in a special fund. The cost of all securities purchased has been charged to that fund, as follows:

Securities were sold for	$1,307,298.07
Securities were acquired at a cost of	1,085,226.56
Leaving a balance	$222,071.51
To this was added from the liquidation of old notes and accounts receivable the sum of	885,996.82
Making a total of	$1,108,068.33

which was used to buy $1,250,000 of the Company's Debentures in the open market at an average price of about 88⅝.

By liquidating as above, and by adhering to the policy of selling for cash or on short time, the Company has not only collected enough cash to retire all its floating and reduce its funded debt, but has had sufficient working capital to pay cash for all its purchases during the year.

The following comparison shows the debt of the Company, other than outstanding debentures and real estate liens, on the 31st days, of January, 1894 and 1895:

	1894	1895
Notes Payable	744,841.31	None.
Accounts payable, accrued interest, &c	446,307.92	494,258.01
Total	$1,190,649.23	$494,258.01
Less cash on hand	591,143.88	404,236.48
Net amount of unfunded debt	$599.505.35	$90,021,53
Paper endorsed and discounted	1,422,949.48	None.
Total	$2,022,454 83	$90,021.53

Reduction of unfunded debt	$509,483.82
Reduction of Real Estate liens	26,200 00
Debentures cancelled	1,250,000.00
Reduction of debt during the year	$1,785,683.82
Reduction of endorsements	1,422,949.48
Total reduction of obligations	$3,208,633.30

Profit and Loss.—It is difficult to separate losses ascertained during the current year into those properly chargeable to this year, and those due to the errors or misfortunes of previous years. The division of the Profit and Loss Statement has been made with a view to exhibit, as far as it could be distinguished, the profit of the year just ended. The losses incurred on notes and accounts, over and above the allowance made therefor last year, are due largely to diminished values of notes and accounts of customers of the Northwest General Electric Company.

The General Expenses decreased $774,832.09 as compared with the previous year.

J. P. ORD, *Second Vice-President.*

CONSOLIDATED BALANCE SHEET, JANUARY 31, 1895.

ASSETS.

Patents and Franchises		$8,159,264 02
Manufacturing Plants		3,900,000 00
REAL ESTATE (other than Manufacturing Plants):		
Edison Building, N. Y. City	$412,584 63	
Less Mortgage thereon	200,000 00	
	212,584 63	
Other Real Estate	211,198 79	
		423,783 42
Stocks and Bonds (see Schedules A and B)		5,079,012 51
Cash	404,236 48	
Notes and Accounts Receivable	6,550,499 50	
Work in Progress	757,087 04	
		7,711,823.02

Inventories:		
At Factories	$3,046,014 59	
At Sales Offices (including consignments).....	813,654 39	
		3,859,668 98
Sundry Debits...		27,989 09
Profit and Loss...		14,794,716.97
		$43,956,958.01

E. & O. E.

J. P. Ord, *Second Vice-President.*

LIABILITIES.

Capital Stock:		
Common...............................	$30,460,000 00	
Preferred................................	4,252,000 00	
		$34,712,000 00
Five Per Cent. Gold Coupon Debentures......		8,750,000 00
Accrued Interest on Debentures..	72,916 65	
Accounts Payable................................	421,341 36	
		494,258 01
		$43,956,958 01

Supplementary Consolidated Profit and Loss Account of January 31, 1894.

Balance, January 31, 1894............		$12,454,967.42
Losses chargeable to further liquidation of last and previous years' business:		
Sundry Liquidation Accounts...... ..	$264,048.36	
Claims against Northwest General Electric Company........	456,484 43	
On Account of Settlements with United Electric Securities Co. of Bond transactions under Thomson-Houston Electric Co.'s Contracts..	46,382.86	
Old Notes and Accounts Receivable wholly charged off..........	234,978.69	
• Sales of Plants and Real Estate below book values	41,501.97	
		1,043,391.31
Special Allowance (see page 2)......		2,000,000.00
		$15,498,358.73
Profits belonging to last and previous years' business:		
Discount on Debentures purchased..	$141,931.67	
Sales of Stocks and Bonds in excess of book values	147,067.37	
		$288,999.04
Balance Carried down...		15,209,359 69
		$15,498,358.73

Consolidated Profit and Loss Account of January 31, 1895.

Adjusted Balance as of January 31, 1894. . ...$15,209,359.69

Business of the Current Year:			
Cost of Goods Sold...	$9,557,327.69		
Legal and General Expenses and Taxes................................	1,894,536.29		
		$11,451,863.98	
Interest on Debentures.............		464,583 33	
			11,916,447.31
Losses chargeable partly to previous and partly to current years' business:			
Consignments and Contracts written off.........		134,772.96	
Additional Depreciation allowed for:			
On Plants, Consignments and Contracts..............	177,417.50		
On Notes and Accounts Receivable................	130,833.50		
		308,251 00	
		443,023.96	
Further Amounts now charged off:			
Patents and Franchises..............	162,298.11		
Various Inventories.................	288,401.14		
Sundry Losses.........	38,798 34		
		489,497.59	
			932,521.55
			$28,058,328.55

E. & O. E.

J. P. Ord, *Second Vice-President.*

Business of the current year:			
Sales..$12,540,395.12			
Royalties and Sundry Profits.......	420,818 17		
		$12,961,213.29	
Interest and Dividends on Securities.	187,946.81		
Interest and Discount	114,451.48		
		302,396.29	
			$13,263,611 58
Balance, January 31, 1895..........			14,794,716 97
			$28,058,328 55

SALE OF WADDELL-ENTZ PATENTS, MAY 22.

Judge Robinson, in the Superior Court at Bridgeport, Conn., has ordered the sale of the patents, both in this country and in Europe, belonging to the Waddell-Entz Electric Company. They will be sold at public auction at the County Court House in Bridgeport, May 22. The Waddell-Entz Company owned a storage battery system operated on the Second Avenue Line in New York City, as well as dynamo and motor patents. Some time ago receivers were appointed in Connecticut and New York, but the affairs of the company were in such shape that no reorganization could be effected. Anton Knauth represents the New York creditors.

WOOLF ELECTRIC DISINFECTING CO.

John Kean has been appointed receiver for the Woolf Electric Disinfecting Co., of New York, which has an office at 66 Broad Street and a factory at Ravenswood, L. I., on the application of John H. Miller, the counsel for the company, who is a creditor for $3,855. The liabilities are about $33,000, and the tangible assets probably $5,000. Hazen L. Hoyt, formerly proprietor of the Victoria Hotel, is the President of the company, and is a creditor for $25,849. The company will in all probability be reorganized.

AFFAIRS OF THE POSTAL TELEGRAPH CO.

The capital stock of the Postal Telegraph Company is now $15,000,000, and represents the cost of the property. The company has practically completed its extensions and has a compact admirable plant for telegraph business. It has two routes through to the Pacific coast, northern and southern, and the lines are built in the most thorough manner.

The company has about 1,900 offices, 18,000 miles of pole line and over 100,000 miles of wire. It has no bonded debt or fixed charges, and is and has been for some time earning substantial dividends on the stock. Its close alliance with the Commercial Cable Company is of great value.

It is now said that in the near future the stock of the company will be listed on the New York Stock Exchange.

Charles E. Chapin, dealer in electrical supplies at 136 Liberty Street, New York, has made an assignment to John K. Creevey, giving a preference to M. A. Glazier Chapin, his wife.

Philadelphia, Pa.—An assignment for benefit of creditors to Isaac D. Sailer has been recorded by Nardi, Strang & Co., electrical engineers, with offices at No. 1721½ Chestnut street.

The Sweet Electric and Mfg. Company, Grand Rapids, has filed with the city clerk a mortgage to E. H. Donnally as trustee. The mortgage covers all the company's stock, patents, accounts, etc., and is given to secure over $12,000 indebtedness due on labor and other claims.

Rochester, N. Y.—An order has been granted by Judge W. E. Werner appointing E. A. Marsh, of Keeler, Salisbury, Marsh & Ward receiver of the Proctor-Raymond Electric company. It was organized March 8, 1893, with a capital of $20,000, which was soon after increased to $30,000. The business of the company was the manufacture of electrical specialties, such as electric bells, etc.

CHANGES IN THE MAGNETIC PERMEABILITY OF IRON.

It is found that the magnetic permeability of the iron cores of electric transformers suffers a gradual decrease. This subject has been investigated by Mr. W. H. Mordey, who has communicated the result of his researches to the Royal Society, through Dr. Sylvanus P. Thompson, F.R.S. He first sought to determine whether the increased amount of electric energy necessary to magnetize the cores was due to eddy currents being set up in the coils by partial failure of the insulation between adjacent portions of the conductor, or to eddy currents in the iron due to change in the insulating material interposed between the thin plates of iron of which the transformers are composed. Examination showed that neither explanation was tenable. He next investigated the effect of long-continued heat, since the temperature of the iron of transformers is, in working, usually 20 deg. to 60 deg. Cent. above the surrounding atmosphere. Samples of iron were kept for months in an oven at temperatures varying from about 60 deg. to 70 deg. Cent. and were tested from time to time. The conclusions to which these observations have led, so far as they have gone, are: 1. The effect is not fatigue of the iron caused directly by repeated magnetic reversals—it is not "progressive magnetic fatigue." 2. Neither magnetic nor electric action is necessary to its production. 3. It is a physical change resulting from long-continued heating at a very moderate temperature. 4. It appears to be greater if pressure is applied during heating. 5. It is not produced when the iron is not allowed to rise more than a few degrees above the ordinary atmosphere. 6. It is similar to the effect produced by hammering, rolling, or by heating to redness and cooling quickly. 7. The iron returns to its original condition on re-annealing. 8. It does not return to its original condition if kept unused and at ordinary atmospheric temperatures, whether the periods of rest are short or long.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 30, 1895.

Alarms and Signals:—

Electrical Signaling System, B. A. Fiske, United States Navy, 538,247. Filed Dec. 20, 1894.

The object of the invention is to provide a signaling system whereby from a given station, an order may be sent to a distant point and whereby, through the mechanical execution of said order, a knowledge that the same has been obeyed will be transmitted back to the originating station.

Accumulators:—

Method of Making Electrodes for Secondary Batteries, W. L. Silvey, Dayton, Ohio, 538,528. Filed Jan. 22, 1894.

Claim 1.—The method of preparing at one operation a positive and negative secondary battery electrode, which consists in applying a paste composed of water and a mixture of low oxide of lead, finely divided metallic lead, and superficially oxidized particles of metallic lead to a support to form the negative plate, and a paste composed of sulphuric acid and water and a high oxide of lead, finely divided metallic lead, and superficially oxidized particles of metallic lead to a support to form the positive plate, and then pickling the two sets of plates in an acid solution.

Conductors, Conduits and Insulators:—

Electrical Coupling, M. F. Koenig & I. Mann, Hazleton, Pa., 538,428. Filed Oct. 15, 1894.

Comprises hollow portions to receive the ends of the wire, and interlocking portions embodying a triple spring tongue.

Insulating Material, J. W. Kidwell, Washington, D. C., 538,614. Filed Sept. 8, 1894.

In producing a hundred pounds, uses from seventy-five to eighty-five pounds of titanic mineral, from ten to twenty pounds of asphaltum and about five pounds of rice hulls.

Dynamos and Motors:—

Brush Holder, E. D. Priest, Lynn, Mass., 538,281. Filed Aug. 25, 1893.

Details of construction.

Armature for Dynamos and Electric Motors, H. Penn & L. Lowndes, London, Eng., 538,344. Filed Aug. 13, 1894.

Employs corrugated sheet iron discs in combination with corrugated end plates.

Dynamo Electric Machine or Electric Motor, E. H. Porter, Radford, Va., 538,345. Filed Aug. 11, 1894.

Claim 1.—A dynamo or motor consisting of a single magnetic frame having six pole pieces with coils and armatures embraced therein in such relation that each has a four pole field.

Electric Engine, L. M. Sabin, Washington, D. C., 538,351. Filed Apl. 27, 1894.

A reciprocating electric motor in which one solenoid vibrates within the other and means for avoiding the effects of induced currents at the reversals.

Electric Elevator, N. O. Lindstrom, Union Course, N. Y., 538,377. Filed Feb. 26, 1895.

An electric elevator comprising a shunt wound driving electric motor, means on the car for controlling the motor-circuit, an auxiliary reversely wound motor coil, and a switch on the car connecting it in circuit to graduate the speed.

Commutator Brush and Means for Adjusting Same, R. Lundell, Brooklyn, N. Y., 538,617. Filed July 20, 1893.

The brushes are carried on a revolving ring and projections located in their path raise the brushes from the commutator.

Electro-Metallurgy:—

Magnetic Ore-Separator, J. W. Carter, Brooklyn, N. Y., 538,320. Filed Dec. 30, 1893.

Details of construction; permanent magnets being employed.

Process of and Apparatus for Making Compressed Electrolytic Copper, F. L. M. Urruty, Paris, France, 538,359. Filed May 2, 1894.

Employs as a cathode laminating rollers which compress the metal deposited thereon.

Magnetic Ore Separator, H. Houlehan, Chicago, Ill., 538,417. June 6, 1894.

The object of the invention is to provide a magnetic separator, which shall operate to separate, by magnetism, from the ore the precious metals, as well as the magnetic metals.

Process and Reagent for Recovering Silver and Gold from Solutions, E. D. Kendall, Sewaren, N. J., 538,522. Filed Nov. 6, 1894.

Subjects the cyanide solution to the action of a pulverized amalgam of mercury and zinc and an appropriate metallic reagent; the precipitate is subjected to the action of granulated carbon in contact therewith in dilute acid.

Lamps and Appurtenances:—

Changeable Electric Headlight, W. Dibb & F. C. Rorabeck, Syracuse, N. Y., 538,248. Filed Mch. 19, 1894.

Adapted for use on electric cars. Makes contact automatically on insertion in a suitable board.

Electric Arc Lamp, J. A. Mosher, Chicago, Ill., 538,457. Filed Feb. 8, 1893.

An alternating arc lamp embodying a magnet, the armature of which consists of laminated plates arranged fan-shaped.

Miscellaneous:—

Electrically and Chemically Heated Crucible, H. G. O'Neill, Boston, Mass., 538,271. Filed Mch. 24, 1894.

Claim.—In an electro-chemical crucible or furnace a mixture of diatomaceous earth and carbonaceous material with a containing receptacle and electric circuit connections arranged and adapted to send a current of electricity through the said mixture.

Electrical Cigar Lighter, H. G. O'Neill, Boston, Mass., 538,272. Filed Aug. 27, 1894.

The construction is such as to prevent the ashes of the ignited tobacco from accumulating upon and remaining in contact with the resistance employed as the source of heat.

Manufacture of Carbon for Electrical Purposes, C. P. Shrewsbury, London, Eng. & J. L. Dobell, Modbury, Eng., 538,289. Filed Sept. 10, 1894.

Combines anthracite coal, bituminous coal and tar or pitch or tar and pitch in such proportions as to constitute a material which contracts when exposed to heat, submitting the same to pressure and baking the articles formed therefrom.

Lightning Rod, H. Simpson, Burlington, Wis., 538,608. Filed March 2, 1895.

A tubular rod is perforated and the perforation surrounded by a cup so that water flowing down the outside of the pipe at its upper end is directed into the interior of the pipe to the bottom so as to afford a good ground.

Railways and Appliances:—

Electrical Brake, C. E. Pearson, St. Louis, Mo., 538,275. Filed April 2, 1894.

A pole piece acting on a core is magnetized by coils thrown in circuit successively.

Trolley, J. D. Swacick, Canton, Ohio, 538,295. Filed Oct. 29, 1894.

The object of the invention is to provide adjustable journal bearings, and means for oiling the bearings.

Means for Ventilating Electric Motors on Cars, J. J. Devine, Clifton Heights, Pa., 538,335. Filed March 14, 1895.

The motor is enclosed in a box ventilated by means of air passages.

Underground Electric Railway, J. F. Smith, New York, 538,357. Filed Aug. 15, 1894.

Consists of H-shaped sections arranged end to end and slot-rails provided with parallel flanges which receive between them the upper edges of the sections.

Conduit System for Electric Railways, F. H. Homan, Brooklyn, N. Y., 538,378. Filed April 24, 1894.

A trolley carried by the car is arranged to depress a flexible conductor composed of insulated sections into contact with branch conductors leading to an insulated prime conductor.

Trolley Breaker, W. R. Scott, Buffalo, N. Y., 538,390. Filed Dec. 19, 1894.

Trolley Wire Hanger, W. R. Scott, Buffalo, N. Y., 538,391. Filed Mch. 5, 1895.

Employs a clamping cam which bears against the trolley wire.

Electric Transmission Wheel or Trolley, C. C. Burton, Pittsburg, Pa., 538,-403. Filed Aug. 11, 1894.

A series of contact blocks are mounted in the rim and extend over a rubber tube.

Rail Connector, L. E. Myers, Chicago, Ill., 538,458. Filed Dec. 19, 1894.

Consists of a connecting wire, and split sleeves or thimbles adapted to receive the wire and to be driven into the holes in the rails.

Trolley Pole Restrainer, F. Wheeler, Meriden, Conn., 538,569. Filed Feb. 8, 1895.

Automatically pulls down the trolley pole immediately upon the trolley leaving the wire and the pulling taut cord.

Block System and Apparatus on Electric Railways, E. Langen, Cologne. Germany, 538,590. Filed July 16, 1894.

The conductors are controlled by switches in blocks so that no train can enter the section upon which another train is situated.

Switches and Cut-Outs:—

Thermal Cut-Out Device, C. A. Rolfe, Chicago, Ill., 538,284. Filed Feb. 21, 1895.

A spring and high resistance wire are embedded in the fuse and rupture the circuit quickly on the softening of the fuse metal.

Telephones and Apparatus:—

Telephone Central Office System, E. T. Gilliland, Pelham Manor, N. Y., 538,327. Filed June 5, 1894.

Provides a system in which when two subscribers are connected the annunciator drop of one of them is retained in the circuit as a clearing out drop while the other is shunted out. Special clearing out drops are therefore unnecessary.

Magneto Transmitter, E. T. Gilliland, Pelham Manor, N. Y., 538,328. Filed June 5, 1894.

Details of construction involving method of support.

Magneto Generator, E. T. Gilliland, Pelham Manor, N. Y., 538,329. Filed Nov. 28, 1894.

Details of construction.

Telephone Switch, A. F. W. Meyer, Blue Island, Ill., 538,454. Filed Jan. 11, 1895.

Details of construction.

EXHIBITION PLANS OF THE N. E. L. A.

An important and very interesting meeting of the National Electric Light Association Executive Committee was held at the Grand Central Palace, Lexington Ave., this city, on May 4, preceeded by an excellent dinner. President C. H. Wilmerding took the chair. The Association was represented also by Messrs. F. Nicholls, E. F. Peck, C. R. Huntley, J. J. Burleigh, A. J. De Camp, G. A. Redman, W. R. Gardiner, J. A. Seely, C. O. Baker Jr., E. H. Davis, G. F. Porter. The electrical press was represented by W. F. Osborne, S. L. Coles, B. E. Greene, J. L. Gans, W. D. Weaver and T. C. Martim. The guests in addition to these were R. B. Corey, M. Nathan, H. Harrison, and D. R. Urquhart.

After dinner, it was decided unanimously upon a full but brief discussion that it lay in the power of the Executive Committee to fix specially, if it deemed advisable, the time of meeting; and it was further decided to hold the next annual meeting in New York City some time in May. The question next came up of having a specially fine exhibit under the auspices of the Association, utilizing the admirable resources of the Grand Central Palace. Finally upon motion of Mr. Nicholls this was referred to a committee composed of the vice-presidents of the Association, with Messrs. De Camp, Huntley and Seely. Forcible addresses were made by Messrs. Huntley, Seely, De Camp, Burleigh and others on the project, ventilating the idea pretty thoroughly. After adjournment, a tour of inspection was made of the building, to size up its facilities.

MEETING OF THE TELEGRAPHIC HISTORICAL SOCIETY AT WASHINGTON.

Thanks to the efforts of Mr. G. C. Maynard, a very interesting meeting of the above society was held last week. It now has a membership of 205. A number of interesting papers and documents were presented, the authors being Messrs. E. L. Morse, H. A. Reed, J. D. Reid, F. L. Pope and others. Much of the matter gone over will be found in THE ELECTRICAL ENGINEER of August 19, 1891, and May 23, 1894. The meeting was most instructive and interesting. The officers for this year are A. B. Cornell, president; first vice-president, S. H. Kauffman; second, W. B. Wilson; third, T. D. Lockwood; secretary and treasurer, G. C. Maynard.

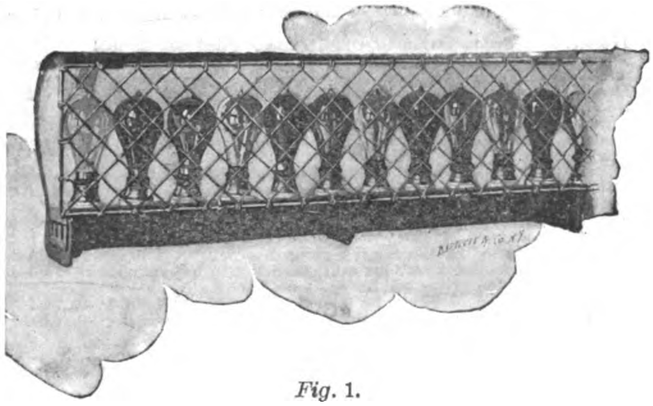


Fig. 1.

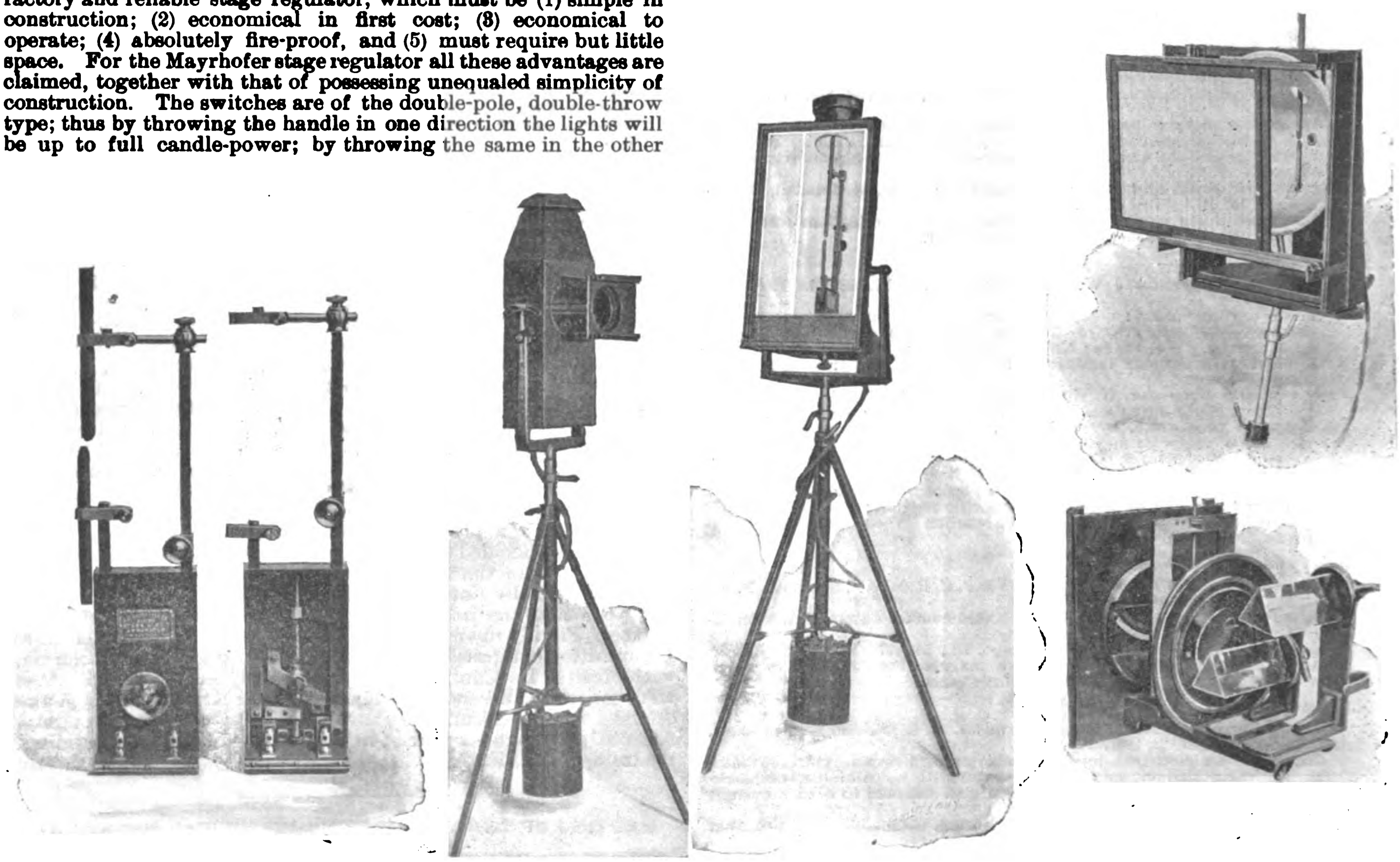
THE MAYRHOFER APPARATUS FOR THEATRE AND STAGE LIGHTING.

One of the most important of the many offshoots of commercial and decorative lighting is the illumination of the theatre and the stage. That this branch of lighting has been brought to a point of excellence never before regarded as possible, is made apparent by a glance through the catalogue just issued by the Mayrhofer Electric Stage Lighting Company of their improved appliances. The aim of this company, which has exceptional facilities for designing and manufacturing stage lighting instruments, is to provide a system complete in every respect. Most of the wonderful effects of light and color in Professor Garrett Serviss' clever lecture on Urania, were designed by Mr. J. C. Mayrhofer, who has since then made remarkable strides in the new art in which he has done such excellent pioneer service.

The first essential in the electric lighting of the stage is a satisfactory and reliable stage regulator, which must be (1) simple in construction; (2) economical in first cost; (3) economical to operate; (4) absolutely fire-proof, and (5) must require but little space. For the Mayrhofer stage regulator all these advantages are claimed, together with that of possessing unequaled simplicity of construction. The switches are of the double-pole, double-throw type; thus by throwing the handle in one direction the lights will be up to full candle-power; by throwing the same in the other direction the lights will be in the resistance circuit. The arrangement of switches is such that each vertical row controls one border of white, red and blue lamps. The sunflower switch mechanism is as simple, strong and durable as it is possible to make it and is placed on top of the resistance coil, the latter being located in front of the board and resting upon an iron plate.

All materials used in the construction of the regulator are incombustible, and therefore absolutely fire-proof.

The regulator is built for either the two or three-wire system, direct or alternating current.



Figs. 2, 5, 3, 4 and 8.—Mayrhofer Apparatus for Theatre and Stage Lighting.

To produce a very fine gradation of light, the resistance coils are provided with at least 50 steps, so that the lights may be varied by almost imperceptible stages. Another and quite important feature of the regulator is the extreme simplicity with which the most beautiful color effects are produced; the coils, one for each border, being constructed in such a manner that either one or two of the three colors can be thrown on the resistance at the same time, and each color dimmed independently of the others.

In the Mayrhofer system of regulation, a separate house switchboard is used to control the auditorium. This board is made like the stage regulator, alongside of which it is placed. It is provided with one, two or more resistance coils to meet any requirements. A portable stage regulator is built for travelling companies. This regulator ranges from 25 to 1000 lights capacity and its employment by a company on the road makes the manager entirely independent of the lighting arrangements of the local theatres. An important advantage of this regulator is the fact that it can be connected to either direct or alternating current.

In the designing of borders, electric and combination (gas and electric), the object of the company has been to combine cheapness with simplicity, durability and safety. The borders are made of the best fire-proof material. Fig. 1 illustrates the border lights built by the company. The opening of the border is provided with a screen of galvanized wire netting, to protect the lamps in raising or lowering the drops.

The hand-feed lamp shown in Fig. 2 is simple and efficient. It has no electro-magnetic devices, no complicated connections, no coils to burn out, and the operator has absolute control over it. This lamp is designed for use on direct or alternating current, and is, therefore, specially fitted for use on the road. By turning a milled screw-head the feeding of the carbons is effected in such a way that the arc is always maintained directly in the focus of the reflector. The advantage of a hand-feed over an automatic focussing lamp will be fully appreciated, where permanent changes in light and color effects are required, as in most cases of theatrical arc lighting. Violent fluctuations in the strength of the current (produced by temporary variation of the load on the circuit) do not affect the steadiness of the arc in a hand-feed lamp, while in an automatic lamp, the arc is unsteady, flames and sometimes hisses.

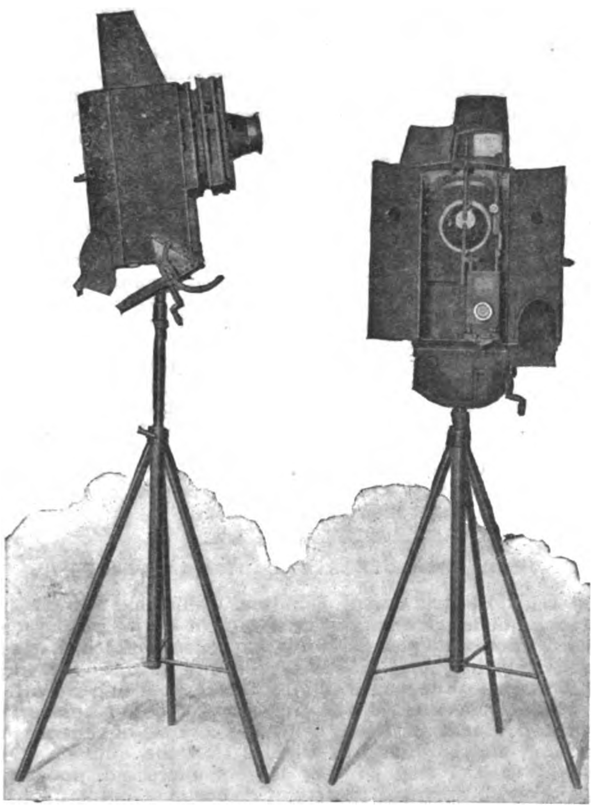
The open box arc lamp, Fig. 3, is especially designed to take the place of calcium lights. It is claimed to give from four to ten times more light and to be easier to operate. It consists of the hand-feed arc lamp, a sheet-iron case with color slides, and a wrought-iron stand with a device by means of which the light may be thrown in any direction.

The gallery reflector arc lamp, Fig. 4, ranges from 8,000 to 10,000 candle-power. This powerful lamp, which is provided with a 16-inch parabolic silver reflector, illuminates the entire stage by a broad silvery cone of light. It consists of a hand-feed arc lamp, reflector, adjustable mountings, double color slides, resistance coil and a five-color graduator.

The single condenser arc lamp or "chaser," Fig. 5, is adapted for projecting a beam of light on stationary or moving objects. This lamp is provided with a graduator by means of which the light can be changed to five different colors.

The standard arc sciopticon, Figs. 6 and 7, embodies every modern improvement, and enables numberless new and beautiful effects to be obtained. It is built entirely of metal. All the mechanical devices to manipulate it and obtain the various effects are designed so as to be perfectly rigid, and in operating the effects no vibration is perceptible. The construction of the case is such as to readily allow the different changes from an open box light to a reflector or simple lens light, thus making the sciopticon practically a universal lamp for any stage arc lighting, to be substituted for calciums or to be used as an effect arc lamp.

Among the effects which the arc sciopticon renders possible may be mentioned a true imitation of sunrise and sunset, a perfect moonlight, and moon and sun eclipses. The sunrise instrument produces a red glow at dawn and as the sun continues its



FIGS. 6 AND 7.—THE MAYRHOFER STANDARD ARC SCIOPTICON.

motion, the color is gradually changed to a bright sunlight. The reflection of the sun or moon on rippling water is simulated, as well as the falling of water either in the shape of a cascade or rain.

The rainbow is imitated by a wonderful optical instrument, the result of several years' experimenting, which reproduces one of the beautiful phenomena of nature in a most realistic manner. No painted slides or old stereopticon methods are employed. The rays of a powerful arc of 8,000 candle-power passing through adjustable double prisms, Fig. 8, are diverted, and by an adjustable mechanical device a partial, primary or secondary rainbow can be produced.

To the Mayrhofer list of optical illusions by means of the arc sciopticon may be added the falling of snow, the dashing of waves, the gathering and passing of clouds across a sky background, rising fire with smoke, sand storms, the fata morgana, the aurora borealis, the play of lightning, and the eruption of a volcano.

Many of the Mayrhofer electro-mechanical effects for which no arc sciopticon is required are most poetical in their conception. For instance, one apparatus gives a most beautiful imitation of the phosphorescent glow of fire-flies in a meadow; another effect is the "Will-o' the Wisp," another the St. Elmo's Fire, the mysterious glow light seen about the masts of vessels, and on the tops of high mountains; another represents gold pouring out of a rock or metal flowing from a furnace. The "Siegfried" effect is a beautiful imitation of the rays of the sun penetrating the leaves and branches of a dense forest and playing with sparkle on the ground.

The Mayrhofer Electric Stage Lighting Co. has its offices at No. 842 Broadway where a show-room designed to show all their types of apparatus and effects in operation is now rapidly nearing completion.

Besides the stage-work directly the National Electric Equipment Company, the agents of the parent Mayrhofer Company, undertake the complete installation of theatre and general electric lighting plants. Thus among other work of this nature they are now furnishing the complete electrical equipment for the new Montauk Theatre in Brooklyn, embracing 3,000 lights which will be controlled by the new Mayrhofer regulator. Mr. W. I. Kilpatrick, a son-in-law of the popular Denman Thompson, is the manager of the company, and Mr. Humphrey D. Davy, superintendent.

MARRIED.

HOWELL–GILCHRIST.

MR. JOHN W. HOWELL, the well-known managing electrical engineer of the General Electric Lamp Works at Harrison, N. J., was married at Grace Church, Newark, N. J., on April 23 to Miss Frederica Bürckle Gilchrist. The ceremony was largely attended, and congratulations were showered upon the happy pair.

OBITUARY.

W. T. LOPER.

W. T. Loper, manager of the United Press in New York city, committed suicide at the Arlington Hotel, Washington, on May 1. Mr. Loper was about forty-five years old and a bachelor. No cause for the suicide is advanced beyond the fact that he was of melancholy disposition and had been in poor health of late. He was a hard worker, a man of culture and wide reading, and accomplished in many directions. Some years ago, one of his feats performed for months together was to report Beecher's sermons stenographically and then send out the report himself over the wire the same day to a number of papers taking the United Press service.

PERSONAL.

MR. E. J. WESSELS, the General Manager of the Genett Air Brake Co., goes abroad on July 3 in view of the development of the large business of the Company, already growing up there. During his trip he expects to cover a considerable portion of England and the Continent.

MR. W. K. L. DICKSON, who has been so long with Mr. Edison in various confidential capacities, and was lately his biographer in a popularly written volume, has resigned from the Laboratory, and has, it is stated, accepted the position of electrical engineer for the Portable Electric Light & Power Co., of which he is an incorporator, and which has its offices in Watts street, this city.

FINANCIAL.

DRIFT OF THE COPPER MARKET.

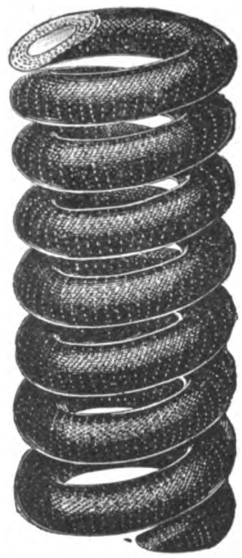
With regard to the future of copper, and the effect of the revival in trade, a large purchaser and close buyer remarked last week to a representative of THE ELECTRICAL ENGINEER: "You refer of course to copper for electrical purposes, viz., Lake Superior and Electrolytic: At present, the price of the former is about 9¾ cents and the latter about 9½ cents per pound. This shows an advance during the past 30 days of about ½ cent per pound; and the present indications point to a still further advance, governed, of course by the demand created in street railway work.

"The price may be governed somewhat by the opening of navigation, thus enabling shipments from Lake Superior via water, which is a saving of ½ cent per pound over all rail; although in my judgment the fact was discounted 60 days ago. One important feature that wants to be taken into consideration as to a future advance in copper is the fact that electrolytic copper is being brought to such perfection that it may eventually, for electrical work, take the place of Calumet & Hecla, or what is known as Lake Copper. Again, it is a well-known fact that the average cost of production of Lake Copper does not exceed 7½ to 8 cents per pound; which shows a very handsome margin even at the present prices."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

PEERLESS SPIRAL PISTON AND VALVE ROD PACKING.



Peerless Spiral Packiug.

The Peerless Rubber Manufacturing Co., of No. 16 Warren St., have issued a circular note in regard to their new specialties. Their piston and valve rod packing is well known, and has been extensively used for the last twenty years. As the exigencies of modern engineering made it desirable to have material of the same excellence in a different form, the Peerless Rubber Mfg. Co. acceded readily to the demands of many engineers, and now make their packing also in spiral shape. In all other respects it is the same as the "Old Reliable" that has held the market so long and favorably.

The enormous growth in the electric light and power industry has brought thousands of plants into existence, where the Peerless packing is welcomed as one of the most valuable adjuncts to the steam equipment.

Of late years the importance of the smaller economies in the operation of electrical plants has been more fully realized. When rates for service were high, the idea of saving on fuel and steam was not urgent. Now, the plant manager is most valued who can prevent wastes before the current actually leaves the machines, and to do this all leaks must be stopped, all joints, &c. properly packed, and each power unit made to do its utmost duty. These are the primary considerations that make the "Peerless" specialties important and necessary.

NEW "PENBERTHY" GREASE CUP.

New "Penberthy Grease Cup."

We illustrate herewith a new grease cup, which has recently been placed on the market by the Penberthy Injector Co., of Detroit, Mich., manufacturers of the "Penberthy" automatic Injector. The name of this company is guarantee as to the quality of any new article which they may put on the market, but the grease cup in question has also many points of superiority, it is claimed, over anything of its kind now in use.

First and foremost the body is a glass cylinder, surrounded and protected by an outer brass shell with openings on four sides through which the user can tell at a glance the amount of grease or dope in the cup and know when to refill it, so that the journal where it is used never need be dry, unless through carelessness. The plunger by which the grease is forced out from the bottom of the cup is made of a heavy rubber washer, protected on both sides by a brass disc, the whole being attached to the bottom of the stem in such a manner that the stem revolves without turning the washer or discs, and at the same time no grease can pass up through the centre of the washer. The cover never needs to be removed from the cup, as the body of the cup is screwed on to the shank and is removed from the shank to be refilled, therefore there is no chance for any of the parts to be lost or mislaid when the cup is being filled. This cup is meeting with a very rapid sale, and while only placed on the market the first of January and advertised scarcely any since that time, the manufacturers say they have been unable to keep up with their orders and are somewhat behind even at the present time, although they started with a fair stock. Circular and price list of this cup will be sent on application to the above company.

The Correspondence School of Technology, Cleveland, O., is moving its offices into the Cuyahoga Building, that city, and will be very comfortably situated there.

HIGH PRESSURE STEAM BOILERS.

Steam users, and more particularly central station operators, are getting to realize more and more the value of high steam pressure. This fact is brought home, not only by the desire for directly reducing the cost of producing power, but also owing to the fact that high steam pressure means corresponding economies in handling and storing coal and in the reduction of space required for a given power, resulting in a saving in real estate and buildings. Whereas twenty years ago the best stationary plants averaged not over sixty-five pounds pressure, to-day pressures of from 185 to 250 pounds are not uncommon, the latter, of course, being employed in connection with compound, triple or quadruple expansion engines.

"High Pressure Steam" is the title of an interesting brochure just issued by the Babcock & Wilcox Co., describing by text and illustrations the method of manufacture of the Babcock & Wilcox boiler. An unique feature of this interesting publication is what might be termed an illustrated specification, consisting of the standard Babcock & Wilcox specification, each section of which is illustrated by the detail to which it refers. We need hardly say that the specification is a model one, and in keeping with the thorough work for which this Company is so well known.

Under the title of "Facts" the same Company have just issued a pamphlet, giving the history of sectional boilers from their inception up to the present, and demonstrating by copious illustrations the numerous types which have come and gone, and detailing their merits and defects. The pamphlet is intended to show that the standard by which all sectional boilers must be gauged is their facility for permitting of thorough cleaning. We need only to mention that both these publications are from the press of Bartlett & Co. to indicate their beauty from the typographic standpoint, and all boiler users will find much to interest them contained within their covers.

GENETT AIR BRAKES TO THE FORE—AND FORTY.

The Genett Air Brake Co. are doing a brisk business as the summer approaches. They have just closed a contract for equipping the Niagara Falls & Buffalo road, for which the White-Crosby Co. are the contracting engineers, and will furnish twenty of their air brakes for the motor cars, and ten trailer equipments; making 30 in all. Last week they also shipped twelve air-brake equipments for the Bristol, England, road; and 43 air brakes are now on the ocean en route for Australia. Inquiries rain in from all quarters, the Company having a good thing to sell backed up by persistent and persuasive advertising.

The Genett Co. have recently moved into new and more commodious offices at 35 Wall street, and will be glad to supply data and information about their excellent brakes.

EDDY EMPLOYEES GET HIGHER WAGES.

The Eddy Electric Co. of Windsor, Conn., has always been noted for a liberal policy in the management of its business, and a new evidence of its possession of the generous spirit that wins, no matter how hot competition may be, is seen in the fact that it has just increased the wages of all its employees 10 per cent. In other words, it has greeted the first sign of better times with a prompt action that of itself helps the coming of general prosperity; and all that one can wish is that the number of employees of the Co. may be very largely increased, month by month, through the rapid growth of its business.

SATURDAY HALF HOLIDAY IN BOSTON.

The following electrical supply dealers of Boston will close their places of business during the months of May, June, July, August and September, at 1 o'clock on Saturdays and 5 o'clock other days:—Pettingell, Andrews Co.; Holtzer Cabot Electric Co.; Anchor Electric Co.; Gillis & Gleeson, Ziegler Electric Co.; Thompson-Brown Electric Co.; Electric Gas Lighting Co.

NEW ENGLAND NOTES.

The Anchor Electric Co., of Boston, have become the New England agents for the sale of the "Iron Clad" ammeters and voltmeters of Elmer G. Willyoung & Co. of Philadelphia who are now selling large quantities of these all over the country. The instruments are in special demand for alternating current work, and their price is a strong recommendation.

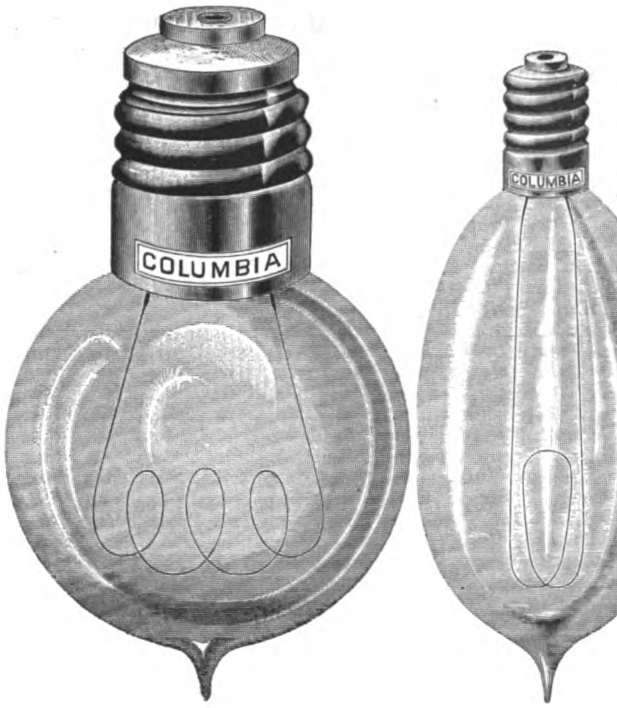
WESTERN NOTES.

The Metropolitan Electric Company have made a new departure by establishing a bargain counter on which can be found a complete line of useful devices at hard time prices. It will be well for the trade to inspect these goods before placing their order. They have also placed on exhibit in their store a sample board showing a very complete assortment of pliers, splicing clamps, vises, etc.

SPECIAL COLUMBIA DECORATIVE INCANDESCENT LAMPS.

The Columbia Incandescent Lamp Co., St. Louis, are placing on the market some special incandescent lamps, particularly adapted for decorative purposes.

Fig. 1 represents the full size 16-candle power coiled filament round bulb incandescent lamp, which is made in high voltages and is very suitable for window and ceiling decorations. The lamps are capable of being used in a horizontal position without any drooping of the filament. They maintain their candle power



FIGS. 1 AND 2.—SPECIAL COLUMBIA DECORATIVE INCANDESCENT LAMPS.

at the high degree of economy of the new type Columbia incandescent lamps, and give a very pretty effect, either clear or in ground glass.

Fig. 2 represents a special candelabra lamp, which is suitable for burning in series on 100 volt circuits and upwards. These lamps used with the small yellow and red silk shades, make a very pretty and harmonious effect.

BALL & WOOD ENGINES.

A visit to the works of the Ball & Wood Co., engine builders, New York, shows engines on the floor in preparation for many western as well as eastern points. Mr. Sargent, the Chicago representative of this company, by the way, has just obtained contracts for several cross compound Ball & Wood engines for the new Milwaukee City Hall.

These engines are also being installed in the Temple of Music, Chicago, Grace Hotel, Fort Dearborn Building, and for Messrs. Morgan & Wright. In St. Paul the Ball & Wood engine recently placed in the Manhattan Building by Mr. Kenyon is attracting very favorable attention. This engine is direct-connected with the Western Electric dynamo, and performs not only very smoothly and noiselessly, but with very close regulation. In New York the list of recent sales of Ball & Wood engines embraces the equipment of the new St. Luke's Hospital on the Heights of Morningside Park, a second engine for the Forty-Second street house of the Manhattan Storage Warehouse Company, several engines for the New York Central Railroad for the new station at Syracuse, these to be connected with the Eddy dynamo; Messrs. Stoutenburgh & Co., of Newark, the well-known clothiers, are also putting in two of these engines; and the Danbury and Bethel Railroad Company, of Danbury, Conn., are having a second 425 H. P. cross compound built for their roads.

FORBES & GLIDDEN.

The above firm has begun business in the Hathaway Building, 630 Atlantic Avenue, Boston, as electrical and chemical engineers. It consists of Mr. Howard C. Forbes, electrical and chemical engineer, and Mr. George B. Glidden. In view of the importance of the two branches above named, it would seem that the firm should enjoy an abundance of patronage. Both gentlemen have many friends in the trade and profession.

PHILADELPHIA NOTES.

BERWICK, PA.—The new foundry which the Jackson & Woodin Mfg. Co. are now building, was designed by the Berlin Iron Bridge Co.

MR. JAMES G. BIDDLE, 525 Drexel Building, well known from his long connection with Queen & Co., is now engaging in business on his own behalf, and as heretofore will make a specialty of electrical measuring instruments and physical apparatus of all kinds. He will handle as special representative the Weston instruments in Philadelphia and vicinity, also the imported apparatus of Elliott Bros. and the Société Génévoise, both world famous concerns. He also is the selling agent for the Chloride accumulators, with special reference to college and medical work. Mr. Biddle does not issue a catalogue, but keeps a carefully revised file of price lists, domestic and foreign, thus constituting his office, above named, a bureau of information.

WARREN WEBSTER & Co., Camden, N. J., specialists in examining steam plants, where increased economy in fuel is desired by utilizing waste exhaust steam, report that there is considerable activity in their business. Among the recent orders for the Webster "Vacuum" Feed Water Heater and Purifier they mention the following:—Estate of John Nesmith, Lowell, Mass., 100 H. P.; New Orleans Railway & Mill Supply Co., New Orleans, La., 200 H. P.; The Proctor & Gamble Co.. Ivorydale, Ohio, 3000 H. P.; Pennsylvania Tin Plate Co., New Kensington, Pa., 2-500 H. P.; Norwich Printing, Dyeing & Finishing Co., Norwich, Conn.. 3000 H. P.; Water and Light Co.. Harrisburg, Pa., 500 H. P.; J. Horne & Co., Pittsburg, Pa.. 250 H. P; A. Hubbard & Co., Norwich, Conn., 300 H. P.; W. F. Slade & Co., Pascoag, R. I., 500 H. P.; Nashua River Paper Co., East Pepperill, Mass., 600 H. P.; Standard Steel Works, Burnham, Pa., (Duplicate), 400 H. P.; Aultman & Taylor Machinery Co., Mansfield, Ohio, 500 H. P.; F. S. Field & Co., Boonton, N. J., 300 H. P.; Pulaski Iron Co., Pulaski City, Pa., 300 H. P.; Russell & Co., Massillon, Ohio, 400 H. P.; Arbegast & Bastain, Allentown, Pa., 150 H. P.; Crescent Steel Works, Pittsburgh, Pa.. 750 H. P.; Moro Phillips Chemical Co., Camden, N. J., 450 H. P.; Crane & Waters, Millbury, Mass., 400 H. P. They also report numerous orders for the Webster Separators and Williames Vacuum System of Steam Heating.

NEW YORK NOTES.

THE METROPOLITAN TELEPHONE & TELEGRAPH CO. have applied for a number of new subway extensions.

THE AMERICAN ELECTRICAL MANUFACTURING CO. have removed their New York office to 39 Cortlandt street, Mr. B. Nahm, manager.

DOUBLEDAY, MITCHELL & CO. have removed from 136 Liberty St. to more commodious quarters at 27 Thames St., New York, where they will have more room to handle their electrical specialties.

MR. JAMES S. WILSON, Superintendent of the factory of the American Circular Loom Co., of Boston, was in New York last week and called at the office of THE ELECTRICAL ENGINEER. He had not long to stay, however, as their factory is so busy turning out flexible conduit that his presence there is almost indispensable.

THE MANHATTAN ELECTRIC CONSTRUCTION CO. have just moved into handsome new offices on the New street side of the Edison Building, 44 Broad street. Mr. S. Marsh Young reports that they are rapidly getting into good shape to supply the demand for their specialties.

DR. W. J. MORTON, the electro-therapeutic specialist and lecturer, entertained a number of visitors most interestingly, at his laboratory 19 East Twenty-eighth street, on Thursday, when a variety of new apparatus was shown and demonstrations were made of the electrical principles applicable in the medical treatment of disease.

MESSRS. H. H. BROOKS AND E. G. BERNARD were visitors together to THE ELECTRICAL ENGINEER office last week. Both were extremely busy, and look for steady improvement in electrical conditions right along. Mr. Brooks has been visiting Mr. Bernard at Troy, and has, the latter says, an eye on the purchase of a collar and cuff factory—because both are a tube circular loom insulation!

THE LOMBARD WATER WHEEL GOVERNOR CO., of 61 Hampshire street, Boston, were represented in New York last week by their chief engineer, Mr. Allan V. Garratt, well known to old timers in electric light and power applications. Mr. Garratt is intimately informed on all the later developments, and is lending valuable aid to the use of water in the new phase transmissions now becoming so numerous, which need close regulation of the water power.

THE ADAMS-BAGNALL ELECTRIC CO.

In our last issue some details were given as to the organization of the new Adams-Bagnall Electric Co., of Cleveland, an event which has aroused the greatest interest throughout electrical circles. We are now able to supplement that brief statement of incorporation by some facts in regard to the personnel, etc., of the new Company.

The man whose name heads the new Company, Mr. Thomas E. Adams, had been with the old Brush Company a great many years. He is what is termed, a practical inventor; that is, an invention to him is not an invention unless the new idea puts in concrete form some decidedly advantageous or meritorious point in the device, which must, in his estimation, be accompanied by a reduced cost of manufacture. Mr. Adams is one of the incorporators of the new Company. What Mr. Adams will produce for the Adams-Bagnall Electric Company in the shape of an arc lamp, cannot be told at this writing, but we may make the announcement that in the course of the next few months he will bring out an arc lamp, embodying the very latest ideas and advantages.

Mr. E. J. Bagnall was with the Brush Electric Company for eight years or more, and when there occupied a number of prominent positions, passing through all the practical branches of the factory. For the last seven years, he has been in St. Louis, building and operating electric light plants and stations with entire and thorough success. He was one of the founders of the St. Louis Engineering Company and Consulting Engineer for the Lindell Ry. Co.

The other men who are associated with this combination are: L. H. Rogers, Assistant General Manager of the Brush Electric Co., and General Manager of the Sperry Electric Railway Co.; C. W. Phipps, Superintendent of the Brush Electric Co.; S. E. Cox, secretary and practical manager of the Swan Incandescent Lamp Manufacturing Company; and George Arnold, head of the drafting department of the Brush Electric Company.

Mr. L. H. Rogers is widely known over the United States. He has been with the Brush and General Electric Companies for the past six years, and has been successful in being able to dispose of a great many goods.

Mr. C. W. Phipps, has been with the Brush Company almost from their incorporation. He was sent to Europe by them, in their interests when the Anglo-American Brush Electric Company of London, England, purchased their European patents. Mr. Phipps was also sent to Japan when the Brush apparatus was launched in that country. He has had a very wide experience in the electrical field, especially in the construction and operation of electric plants, and latterly in the superintendence of the large factories of the Brush Company.

Mr. S. E. Cox has, for a number of years, been in the Incandescent Lamp department of the Brush Electric Company. This Company has been a separate organization under the name of the Swan Incandescent Lamp Manufacturing Company. Mr. Cox has proven himself a valuable manager in this department.

Mr. George Arnold has also been connected with the Brush Electric Company for a great many years, and has held various positions of responsibility. His last connection with said Company has been at the head of the Drafting Department, in which position he has shown a decided aptitude in the line of dynamo engineering.

Mr. S. T. Dodd, formerly an instructor at Princeton and latterly with the Brush Co. and the New Jersey Traction Co. has been appointed consulting electrical engineer.

Associated with the above named men, are a number of the best known capitalists in the city of Cleveland, including Mr. Charles G. Hickox and Mr. George W. Howe, two capitalists of Cleveland and business men of very high standing.

Regarding the output of the "A-B" Company, nothing definite can be officially stated at this time. It is positively known, however, that they will make arc lamps, incandescent lamps, and possibly, railway motors. They propose to manufacture anything in the electrical line in which they can clearly see an unvexed profit. The electrical fraternity will await with considerable interest for the appearance of their arc and incandescent lamp which they promise to have on the market within a few months' time.

The officers of the Company, recently elected are as follows; Charles G. Hickox, President; George W. Howe, Vice-President and Treasurer; L. H. Rogers, Manager; S. E. Cox, Secretary, C. W. Phipps, Superintendent.

They have leased the factory No. 47 E. Prospect Street, built for a manual training school and formerly occupied by the Hackney Bicycle Co., and will be ready for receipt of quotations on supplies for the equipment of their factory and the manufacture of goods after this time. The Co. is organized under the laws of the State of Ohio with a capital stock of $150,000.

Mr. C. E. Sargent.—The Ball & Wood Company, engine builders of New York, represented in Chicago by C. E. Sargent, removed their offices on May 1st, to No. 404 Fort Dearborn Building, where all communications should be addressed, and where Mr. Sargent will be very happy to see all his acquaintances.

POPULARITY OF THE LUNDELL FAN MOTOR.

By dint of merit and shrewd, persistent advertising, the Lundell fan motor has been pushed into a very prominent place in the public esteem this year. There can be no question of the fact that it is selling in large quantities; in fact, as the Interior Conduit & Insulation Co. say, without exaggeration, "by the gross." It is now made in such a variety of shapes and sizes, that every taste is consulted, while the new alternating lines reinforce those for the direct in an effective manner, meeting the needs of all circuits. The company and its agents will be glad to send fan motor catalogues on application.

THE NEW WESTINGHOUSE MACHINE SHOPS.

Contracts have been let and ground broken for The Westinghouse Machine Company's new shops at East Pittsburg. A few years ago the Westinghouse Air Brake Company erected large shops at a point on the main line of the Pennsylvania Railroad, about twelve miles from Union Station, Pittsburg, where the town of Wilmerding was laid out and built. The location at East Pittsburg of the Westinghouse Electric & Manufacturing Company's immense plant, and the Fuel Gas & Manufacturing Company's factory, to be followed now by the removal of The Westinghouse Machine Company to the same place, will form, with the Union Switch & Signal Company's works at Swissvale, a concentration of Westinghouse interests practically at one point, within a half-hour's ride of the city.

The main building of The Westinghouse Machine Company's new shops will be 602 ft. x 230 ft. The construction throughout will be as nearly fire-proof as modern building methods can devise. To meet this proposition, the specifications call for a steel structure with brick walls, slate roofs, wire-glass skylights, etc., etc. A building of similar construction, 200 ft. by 60 ft., will contain the hammer shop and power plant.

Within the main building, through which switches are run direct from the main line of the Pennsylvania Railroad, will be the machine shop, erecting shop, foundry, pattern shop, warehouse, offices, etc. Two crane runways, each 60 ft. span, on which electric cranes of the latest improved design will be used, extend the length of the building. The remaining space is taken up with galleries, provided with lighter crane service. The present equipment of machine tools will be increased by the addition of whatever is best, to facilitate the manufacture and handling of the Company's enormous product.

The hammer shop will have every convenience that the best shop practice can suggest, for doing work thoroughly and expeditiously. It will be equipped with one 8-ton, one 3-ton, one 2-ton and several smaller hammers, besides the usual cranes, etc.

It is estimated that the cost of the buildings alone, will reach $400,000. The contracts call for completion November 1st, 1895.

MATERIAL WANTED.

Purchases for machinery and material for a complete electric light plant for Guayaquil, Ecuador, S. A., will be made at the office of Geo. F. Woolston, 40 Wall Street, N. Y.

FOREST CITY ELECTRIC WORKS.

The Forest City Electric Works of Cleveland, Ohio, manufacturers of the well-known roll drop commutator segments for dynamos and motors has established an office in New York which will have general oversight of the Eastern territory.

Mr. John C. Dolph, formerly connected with the Short Electric Railway Co. and for the past two years Eastern representative of the Eureka Tempered Copper Co., has been appointed Manager of the above district. It is the policy of the company to push vigorously the sale of their products in Eastern territory. A large stock of standard street railway and lighting segments will be carried in their New York store room, 126 Liberty street.

WESTERN NOTES.

George Cutter, The Rookery, is sending out an edition of his natty little pamphlet on "Electric Street Lighting Specialties." It will go in a vest pocket—western size—but is full of good things. Mr. Cutter has made a long study of outdoor lighting, and his appliances, as a result, are highly useful and popular.

The Electric Appliance Company is getting a large share of the telephone supply business which just at present constitutes a very considerable part of the demand for electrical supplies. The fact that they carry in stock in Chicago a very large quantity of telephone line material, such as cross arms, insulators, etc., and can ship almost any kind of order promptly from Chicago, gives them a very valuable prestige which counts for a great deal in the telephone business, nearly all of which to-day is being done in the quickest possible manner.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. MAY 15, 1895. No. 367.

THE THREE-PHASE PLANT OF THE VERMONT ELECTRIC COMPANY AT WINOOSKI, VT.

THE Westinghouse three-phase power plant which has been installed for the Vermont Electric Co., Winooski, Vt., for supplying the city of Burlington with electric power, presents many points of interest.

The electrical equipment of the power house consists of a Westinghouse generator, rated at 46 amperes at 2500 volts, running at 450 revolutions per minute, and having a periodicity of 7200 alternations. The machine over-compounds 10 per cent. at full load. It has 16 poles, with drum wound slotted armature, and triangle construction for three-phase work. It can be belted direct from a turbine, or from a counter shaft, which is in turn driven either by a turbine or steam engine. The exciter is driven from the shaft of the generator.

The transmission line, which is 2½ miles long, consists of No. 0 weather-proof insulated wire. There is also, covering the principal business part of the city, a secondary network of No. 0 wire. The primaries are run on white-glass insulators; the secondaries on green glass.

The secondary mains are fed by two banks of transformers in parallel, each bank consisting of two 18¾ K. W. transformers installed in a brick vault. One vault, out of doors, has a removable tin-covered roof, and is provided with a trap door from which all the fuses may be reached. There are fuses on both the primary and secondary side of this vault. The second vault, which is located in the basement, is similar to the first, except that it has the primary fuses on a pole outside of the building. Both vaults are perfectly ventilated, and each has space for a third transformer when the load shall require it.

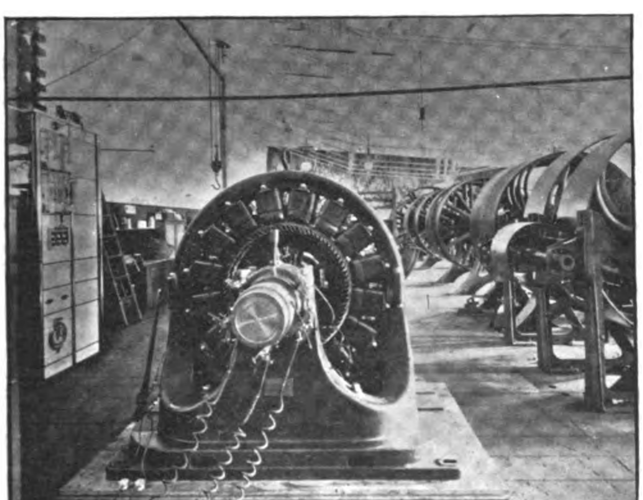


FIG. 1.—THREE-PHASE DYNAMO ROOM, BURLINGTON, VT.

The motors are three-phase, with "cage" wound revolving secondary, and distributed primary windings. They are driving printing presses, elevators, and various manufacturing machinery. The service is excellent and the demand for power is rapidly increasing. A large number of small industries in Winooski rely entirely on the electric power supply, and more than 100 H. P. in small motors is already connected to the set of secondary mains. Many motors in distant parts of the city have individual transformers. At present the transformation is effected by two instead of three transformers in a bank. Each motor has a fuse cut-out, a three-jaw switch, and a Shallenberger recording watt meter. The local company and consumers have arranged to install a meter at each motor, even when several motors are used by the same customer. It is proposed to equip another set of secondary mains in different district of the city before long.

FIG. 2.—THREE-PHASE WATER POWER PLANT, BURLINGTON, VT.

The work of the installation has been carried on under the direction of the manager, Dr. W. S. Vincent. Mr. A. E. Richardson is president of the Company, and Capt. Smith S. Leach, U. S. A., consulting engineer.

E. M. F. IN METALS UNDER STRESS.

An interesting series of experiments have been carried on by Mr. T. Andrews, on the influence of stress on the corrosion of metals, which may have considerable practical applications. Bars of iron or steel were subjected to different stresses, and were then placed in some electrolyte —generally a solution of common salt—and the difference of potential between them measured. It was found that tensile stress caused the production of an average E. M. F. of 0.016 volt between the strained and unstrained bars, the latter being positive. The effect of torsional stress was to produce an average E. M. F. of 0.012 volt in the same direction. Similar results were obtained with flexional strains. From the data obtained, the author deduces a number of interesting conclusions which bear on the corrosion of iron structures, for which the reader is referred to the original paper in the *Proceedings* of the Institution of Civil Engineers, cxviii. 4.

A CHICAGO STOCK YARDS LIGHTING PLANT.

A good example of what can be done with first class appliances when erected in an intelligent manner, is shown in the recently reconstructed lighting plant at the large packing house of Swift & Co. Union Stock Yards, Chicago. It is one of the largest plants of the kind in the west and consists of 7,000 incandescent lights, 100 arc lights and some 25 H. P. in small motors. In addition to this, 150 miles of fire alarm circuits are looked after by the electrical department. The necessary current is furnished by four 1,000 light alternators, three 30 light and one 50 light arc dynamos, two 60 K. W. and two 30 K. W. Edison generators. About 5,000 of the incandescent lamps are operated by the transformer system, the balance by the low pressure direct current.

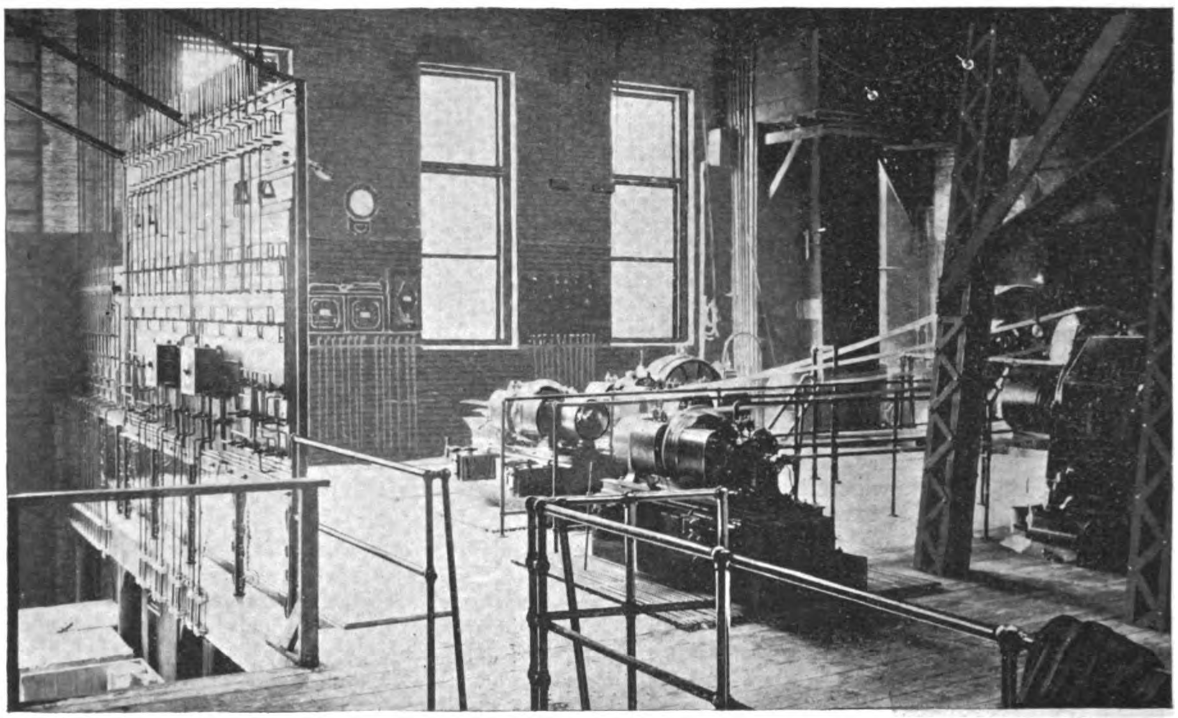
There are 300 miles of circuits, and every foot consists of the best rubber covered wire, not an inch of weather proof wire being used. Of this, all but 120 miles is carried in underground conduits.

Among the most interesting features of the plant are the recently completed incandescent and arc switchboards. These boards which were designed by and constructed under the supervision of Mr. J. Fred Galletly, the company's electrical engineer, are built up of marbleized slate panels, held in a neat iron frame, which binds the panels on all sides. The whole rests on posts set firmly in the ground to a depth of 8 feet, independently of the building. This is a very advantageous arrangement, as it does away with all possible jar and vibration and the attendant liability of loose connections with consequent risk of poor contacts. It also obviates to a large extent the wear on the pivots of the indicating instruments, which under continued vibration are apt to become dull and sluggish.

At the top of the larger board is placed a row of double pole lightning arresters for all the lines from the station to the various departments and buildings of the company. Beneath the lightning arresters are the volt and ammeters, arranged with lamps which render the readings easily discernable. Further down on the board are the line switches. These are all double pole, double throw, and the wiring is so arranged that every possible combination can be made between these and the machine switches, which are arranged in the next row. The latter are also double pole, double throw, and while it is possible to feed any one or more circuits from any desired generator, it is absolutely impossible to throw two machines in multiple.

The back of the board is also a model of ingenuity and execution. In many instances the back of a large switchboard is quite a cobwebby affair. By a very simple arrangement Mr. Galletly has entirely obviated this. The connecting studs projecting from the back of the board were all lengthened, so that connection with the line could be made either close to, or some distance from the board. The result is that there are no criss cross diagonals or tangles back of the board, all wires, if bent at all, are bent at right angles. This gives an air of neatness as well as convenience and safety to the arrangement, which can be attained in no other way.

At the right, the smaller board, equally complete, contains the arc light switches and instruments, the materials and general arrangement being similar to the larger board.



ELECTRIC LIGHTING PLANT, SWIFT PACKING COMPANY, CHICAGO STOCK YARDS.

ON SLOW CHANGES IN THE MAGNETIC PERMEABILITY OF IRON.[1]

BY WILLIAM M. MORDEY.

When iron is magnetized for a long time by rapidly alternating currents, its magnetic permeability is usually reduced, a gradual increase taking place in the amount of energy absorbed in producing a given magnetization. This effect has been observed in connection with the working of transformers on alternate-current systems. Although it has been known for some time to a few electrical engineers, the author is not aware that any investigation or proof has been published as to the cause of this change.

In the first place explanations were sought in direct connection with the magnetic or electric actions that take place. The explanation that first suggested itself was that eddy currents were being set up in the coil by leakage or partial failure of the insulation between adjacent portions of the conductor, or that eddy currents were being set up to an increased degree in the iron by disturbance or change of the insulating material interposed between the thin plates of iron of which the transformers were composed.

The author then describes a number of experiments to determine the effect of subjecting the iron to annealing, heating, mechanical pressure, etc., and arrives at the following conclusions:

1. The effect is not fatigue of the iron caused directly by repeated magnetic reversals—it is not "progressive magnetic fatigue."
2. Neither magnetic nor electric action is necessary to its production.
3. It is a physical change resulting from long-continued heating at a very moderate temperature.
4. It appears to be greater if pressure is applied during heating.
5. It is not produced when the iron is not allowed to rise more than a few degrees above the ordinary atmosphere.
6. It is similar to the effect produced by hammering, rolling, or by heating to redness and cooling quickly.
7. The iron returns to its original condition on re-annealing.
8. It does not return to its original condition if kept unused and at ordinary atmospheric temperatures, whether the periods of rest are short or long.

1. Communicated by Prof. S. P. Thompson to the Royal Society.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE EQUIPMENT OF THE METROPOLITAN ELEVATED RAILWAY, CHICAGO.

The first elevated railroad in the United States, of permanent construction and operated entirely by electricity will shortly be opened to the public in Chicago. This road, about which a large amount of data has already appeared in THE ELECTRICAL ENGINEER, the Metropolitan Elevated Railway, will provide for the first time a means of real rapid transit between the business centre of that city and the immense district lying between the North and South Branches of the Chicago River, known as the West Side, where reside some 800,000 of Chicago's population.

This elevated railway built on its own land was projected by Mr. A. F. Walcott, in 1892, and for this purpose the West Side Construction Company was organized with a capital of $3,000,000, which was taken up at par. A further $9,000,000 was secured by the issue of $10,000,000 worth of five per cent. fifty year bonds at 90. The $12,000,000 thus at the disposal of the Company proved ample to cover the cost of the real estate and the expense of construction and equipment.

When the plans for this road were first drawn up, the use of steam was provided for, the accommodation projected being for forty-ton locomotives and eight car trains. But between the projection of the road and its completion, the General Electric Company had built, equipped and operated successfully entirely by electricity, the Intramural Railway at the Chicago Exposition. The new method of rapid transit proved a revelation to the Chicago Company which immediately began an investigation of the merits of electricity as a motive power, already convinced of its superiority over steam in other directions. The investigation proved that the operation of the road by electricity, in a manner similar to that of the Intramural Railway, would prove not only cheaper but would at the same time offer advantages which could never be acquired by the employment of any other system. Electric motive power was therefore decided upon.

The road starts at Franklin street, where the Board of Trade is situated, in the very heart of the business district, and runs west to Paulina street, a distance of nearly two miles. For this distance, as a four track road has been constructed, it was necessary to get a strip of land, fifty feet wide; then the road, now a double track, goes still further west, past Garfield Park, for over four miles to Forty-eighth street; from Paulina street another two-track line goes more than two and a half miles north to Robey street, thence from Robey street another two-track line runs west two miles by Humboldt Park, to the Chicago, Milwaukee and St. Paul Railway; and on the other side, from Paulina street, a two-track line runs south and west, by Douglas Park to Ogden avenue; making in all 18 miles of road. The main line, the two-mile four track section from the Board of Trade to Paulina street, together with the northwestern branches, which are called the Logan Square and the Humboldt Park lines, covering a total distance of 13¼ miles, are completed, leaving yet to be constructed the Douglas Park or the southwestern line, which is about 3¾ miles in length. On the main line with its four tracks express trains will be run, making the journey in five minutes.

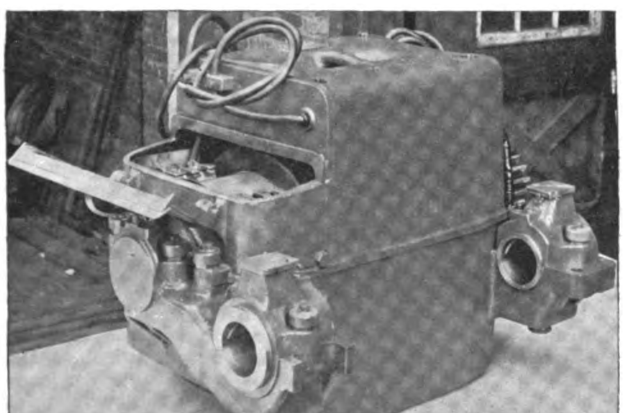


FIG. 1.—GENERAL ELECTRIC MOTOR, METROPOLITAN ELEVATED RAILWAY, CHICAGO.

The road is unique in two respects: It is not only to be operated by electricity, but it is built upon its own purchased right of way. This deviation from all hitherto known methods of securing this right will have its reward in the freedom from law suits which the company will enjoy. No other franchise was asked for than the right to cross certain streets at an elevation. Title to the land was acquired at the expense of about six and a half million dollars, most of the property being held by the company in fee simple.

All the houses worth preserving were carefully moved to other locations, the rest were demolished. Among those moved was the Normandie Flats, the largest stone house ever moved. It was drawn several hundred yards away, without a crack appearing in the walls. The property acquired by the company, will prove a very valuable asset, and projects for its use in other directions besides carrying the road are already afoot. The road passes through the centre of the blocks, and the streets are thus free from the disfigurement which those in New York suffer from the presence of their elevated roads.

The passenger stations, built of rock face pressed brick with stone trimmings are built directly under the track on the street level, stairways leading to the platforms above. The waiting rooms and toilet rooms are all handsomely fitted up. The railway is constructed in a substantial manner, and is built entirely of basic open hearth steel, forged and rolled by the Carnegie Steel Company of Pittsburg.

The power station, situated directly west of the municipal lighting plant on Throop Street near Van Buren Street, is 300 feet long, 90 feet wide and 78 feet high. Its present capacity is 6,000 H. P., but should the service demand an increase, this capacity could be readily doubled, by extending it to take in the site of the municipal lighting plant which has become the property of the Company.

The engines are of the compound inverted vertical direct acting Corliss type, constructed by the Allis Company of Milwaukee. Four of these are already set up in place on solid brick and concrete foundations. Two are of 2,000 H. P. each and two of 1,000 H. P. each. The cylinders of the larger engines measure 36 and 72 x 48 inches stroke, those of the smaller 23 and 43 x 48 inches stroke. The diameter of the shaft in the larger engine is 24 inches; it carries a 70 ton flywheel, 24 feet in diameter with a rim 21 x 20 in. making 75 revolutions per minute. The flywheel in the smaller engines weighs 35 tons, is 17 x 17 inches at the rim, 18 feet in diameter and makes 100 revolutions per minute. Easy access is gained by the galleries to all parts of the engines. Each pair of engines is fitted with two distinct governors, one controlling the point of cut-off, the other connected with a safety valve in the main steam pipe. This is closed the instant the speed exceeds a certain number of revolutions.

The boilers are twelve in number and come from the works of the Babcock & Wilcox Co. Each boiler has a capacity of 300 H.P. and is provided with a Babcock & Wilcox mechanical stoker. They are divided into six batteries of two boilers each, and are designed for a working pressure of 165 pounds. The furnaces are provided with smoke consuming devices, which work so far satisfactorily.

The entire electrical equipment, generators, motors and accessories, was furnished by the General Electric Company. The generating plant consists at present of two 1,500 kilowatt generators similar to those now operating the Brooklyn City Railroad of Brooklyn, and the People's Traction Railroad of Philadelphia; and two 800 kilowatt generators similar to those in the railway power station at Buffalo and at St. Louis. Machines of both these types were shown in operation in the Intramural Power House at the World's Fair.

These generators are of the standard General Electric type. The fields are constructed entirely of steel. The pole pieces in the 1,500 K. W. machine number twelve and in the 800 K. W. machine ten. The armatures are built up of sheet iron laminations which are individually secured to the spider by dove tailed keys. The armature windings consist of hard drawn copper bars, embedded in mica lined slots in the outer armature surface. Special provision in the construction of this armature core is made to ensure thorough ventilation. The field spools can be removed without disturbing the field frame, and both armature bars and commutator segments are individually removable. The question of temperature has received careful attention, and that of these machines is guaranteed not to exceed that of the surrounding atmosphere by more than 46 degrees Centigrade, while in actual practice the temperature rarely rises above 30 to 35 degrees Centigrade. Their commercial efficiency is guaranteed to be not less than 94 per cent. Their design is such that they can stand an overload of 60 per cent. for a short time, and shift from that to no load without sparking at the commutator.

The machines are set up in place between the high and low pressure sides of the engine, and are thus enclosed by the engine frames. The dimensions of the generators are as follows:

	M.P. 1,500 K.W.	M.P. 800 K.W.
Diameter of Field,	15 ft. 10½ in.	12 ft. 6 in.
Width of Field,	3 ft.	2 ft. 6 in.
Diameter of Armature,	10 ft. 6 in.	7 ft. 10½ in.
Width of Armature,	6 ft.	5 ft. 1 in.
Weight of Fields,	104,600 pounds.	60,000 pounds.
" " Armature,	82,100 "	46,000 "
Total weight of Generators,	186,700 "	106,000 "

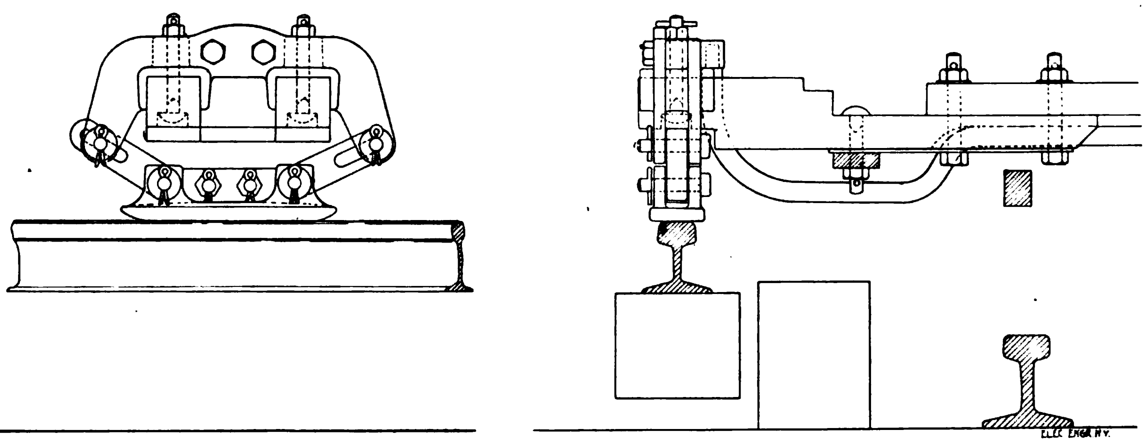
From the generators the current is led over insulated copper cables to the switchboards which are built up of General Electric standard generator and feeder panels. Each of the former is equipped with the necessary field rheostat, lightning arrester, voltmeter plug switch, and positive and negative main switches, both single pole. In addition, it carries a Weston illuminated dial ammeter, and an automatic circuit breaker, which breaks the generator circuit instantly should a dangerous overload be thrown upon the machine by accident. The equalizing switch is mounted on a pedestal near the generator, and the length of the equalizer is thus reduced. The field rheostat and lightning arrester are set at the back of the board, the former being operated from the face by a hand wheel. A discharge resistance is attached to the field rheostat to cushion the discharge when the field switch is opened. It is connected in series with a pilot lamp in front of the panel. The lightning arrester consists of an iron clad electro-magnet in the field of which are two carbon points separated by a one-thirty-second inch air gap. The points are connected between the generator lead and ground; the magnet,

The maximum speed is rated at between 35 and 40 miles an hour on straight and level track.

These motors, one of which is illustrated in the accompanying engraving, are of the single reduction type, thirty-three inches high and fifty inches wide over gears. The field frame is of steel, and the armature of the iron clad type with series drum single turn barrel winding, these windings being set in slots in the outer surface of the core. The motor is thus rendered mechanically staunch and easy of repair. The insulation both in the armature and field is of asbestos and mica, thus making the deterioration of the insulation from heating impossible. It is entirely enclosed and is dust and water-proof. Two doors at the commutator end allow of access to the interior, and the motor can be readily inspected either from above or below. Two of these motors are mounted upon one of the two trucks of the motor cars, one to each axle.

In addition to the motors each car is equipped with two series-parallel controllers especially designed for this work and two electric air compressors for the air brakes. The motors are protected by an automatic main switch which is in this case a "K" automatic circuit breaker. In the operation of the controller when a quick start is desired, the handle is brought round one half a turn to the right, thus bringing the motors into multiple at full speed. If the start is to be the ordinary gradual acceleration, the handle is moved half a turn to the left, and the motors brought up to half speed; another turn in the same direction throws them in multiple and they move forward at full speed. The arrangement is such that each motor takes an equal portion of the load and this is perhaps one of the most important factors in traction work.

The reversing switch which is arranged at the side of the controller and is capable of movement from and toward the motor-



FIGS. 2 AND 3.—CONTACT SHOE ARRANGEMENT, METROPOLITAN ELEVATED RAILWAY, CHICAGO.

between the generator and line, the induction of its windings affording additional protection to the generators against lightning. The lighting switch is single pole and quick break and is connected to the negative terminal main switch. The positive side of the lighting circuit is connected through a magnetic cut-out to the equalizing bus. Current can therefore be supplied for lighting purposes from any generator whether its circuit breaker or main switch is open or closed. The voltmeter is a Weston illuminated dial instrument which is connected by the insertion of a plug in the four point receptacle in front of the board, two of the points of which are connected to the generator between it and the main switch, the other two to the voltmeter bus bars.

The feeder switchboard is divided into a separate panel for each feeder. The overhead line is divided into sections, and each panel corresponding to any one section is equipped with its own circuit breaker. Each panel also carries a Weston ammeter and quick break switch. In addition, the main switchboard is equipped with a "G" recording watt-meter, indicating the total out-put of the station.

From the station the current is conducted by heavy feeder cables to the lateral third rail used as a working conductor. This rail is fastened to heavy timber beams set outside the guard timbers of the regular track. The top of the rail is elevated somewhat above that of the service rails, which are used for the return and are carefully bonded by two copper strips, one on each side, of extra large cross section riveted cold through the holes in the web. Fifty-five motor cars and one hundred trailers will make up the rolling stock of the road at its opening.

The motor cars which are to be used were described in our issue of April 24. The motors are known as G. E. 2000, a title explained by the power of the motor which is rated at 2000 pound horizontal drawbar pull through a thirty-three inch wheel at twenty miles an hour. The rated capacity in horse power is 100 H. P. under normal conditions, and 150 H. P. for short intervals.

man is equipped with a safety interlocking device. This operates to render the reversal of the motors impossible should the controller handle not be in the right position. As in the "K" controller, this one is equipped throughout with the G. E. magnetic blow-out.

Current is taken from the third rail by a contact shoe, illustrated in Figs. 2 and 3, which hangs from an oaken beam projecting from the side of the truck. The shoe is suspended by means of links which allow of its accommodating itself to any unevenness of the rail or track. Each motor truck is equipped with two of these, one on either side. Going north the right shoe is in contact, going south the left shoe. The road has no loops at the terminals.

Each motor car is provided with two motorman's compartments built out upon the platforms, set diagonally at the opposite ends. Each compartment contains its own controller, and pump.

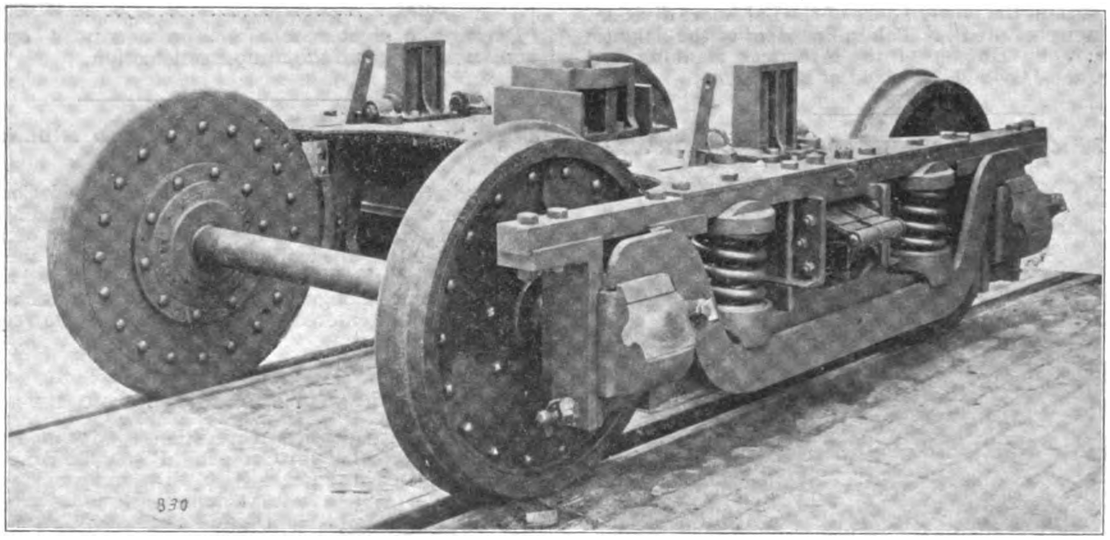
The trains will consist at first of one motor car, fitted up as a smoking car, and three trailers. Each motor car fully loaded and equipped will weigh 63,500 pounds, each trailer car loaded 46,000 pounds. With the two motor cars and three trailers the average speed will be 18 miles an hour, measured on the tangents of the Garfield Park line, including stops of 15 seconds each at stations approximately 2,000 feet apart. The present plans contemplate the eventual adoption of six car trains made up of one motor car, equipped with four G. E. 2,000 motors, and five trailers. The average speed of these trains, on the Garfield Park tangents, will be fifteen miles an hour including stops.

MR. YERKES says that the results with the trolley on the north and west sides of Chicago show an increase in gross receipts which amounts to about 30 per cent. on an average. Notwithstanding the handling of greater traffic, he says, "this increase is all saved to net earnings through the smaller cost of operating electric cars."

ELECTRICAL EQUIPMENT FOR THE N. Y. & N. H. NANTASKET RAILROAD.

It will be remembered by readers of THE ELECTRICAL ENGINEER that the New York, New Haven & Hartford R. R. is equipping its Nantasket Beach branch electrically. Some details of the plant were given in these pages, March 6, by President C. P. Clark. The Company propose to use a No. 0000 copper trolley wire with naked feed wires carried upon iron arms bolted to Southern pine poles, 30 ft. in length, 12×14 inches at the butt and 10×12 inches at the top. These poles are to be located between the tracks which are being laid to 13 feet centres. The equipment is to be made interchangeable with the standard steam cars and at first will consist of six motor cars, each with two motors of 100 H. P. nominal capacity each. These are expected to draw with ease a trailer car. Both these motor and trailer cars are 50 ft. in length, open cars, lighted with electricity and entered from the side. In addition to this, the Company are preparing four baggage cars, 30 ft. in length, of which two are to be fitted with two motors and two with four motors, all of the General Electric Company's construction. By loading these baggage cars and so increasing their tractive force, the Company's engineers expect to determine the efficiency of special motors.

We show herewith, in addition to the above, an engraving from the *Railroad Gazette* of one of the motor trucks now being built for the Nantasket Beach branch, by the Baldwin Locomotive Works. The truck is very heavily built, having wrought iron side frames with loose pedestals bolted in position, and intermediate braces as well. The journal boxes are of cast-iron with heavy brasses neatly fitted to prevent variation in axle centres. The centre plates and cross-ties are made of steel and form the receptacle for the swinging bolster, which is also of steel. The bolster springs are double elliptic, and in connection with them there are provided the coil springs common to passenger car trucks to transfer the load to the equalizing beams and thence to the journals. All parts have been accurately fitted to gauges and every piece is interchangeable.



ELECTRIC MOTOR TRUCK—NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

A PROJECT is on foot in Philadelphia to utilize street railways for carrying freight as well as passengers. The plan proposed is a combination of the express business and the parcel delivery.

AN ELECTRIC RAILWAY FROM MASSACHUSETTS TO CANADA.

Charles Corliss and Thomas Sanders, of Haverhill, Mass., have asked the legislatures of Massachusetts and New Hampshire for a charter to operate an electric railway from Haverhill through the Merrimac and St. Lawrence valleys.

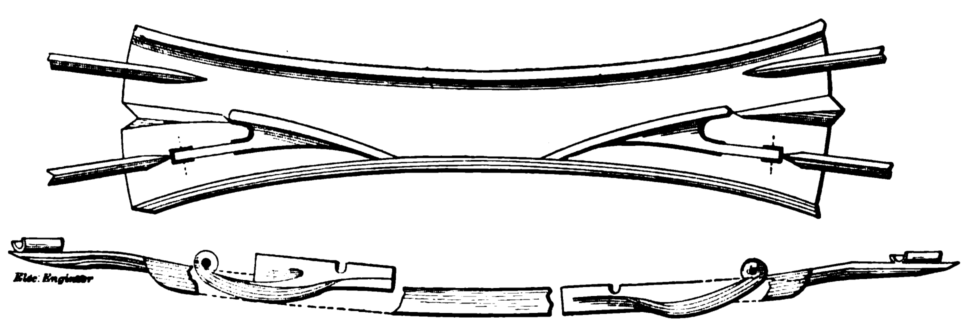
The New Hampshire line begins at Haverhill, Mass., runs twenty miles due west to Nashua, N. H., thence up the Merrimac Valley to Manchester, Concord, Franklin and Plymouth, to Fabyan's, thence continuing northerly to the Connecticut lakes and crossing the Canadian boundary to Victoria and the Canadian Pacific Railway at Gould, extends to St. Francis, on the Chaudiere River, and thence to South Quebec.

Through the efforts of Hon. Louis Philippe Pellitier, M. P., of Quebec, and his associates, charters have been secured in the five Canadian counties touching New Hampshire on the north.

The other branch of the road begins at Haverhill and runs through Maine, traversing the Kennebec valley and crossing the Canadian border near Bald Mountain.

THE KROGER GRAVITY TROLLEY SWITCH.

No detail of overhead railway equipment requires greater care in construction and perhaps none has given more trouble in practical operation than the switches and cross-overs. Our readers will therefore be interested in a device of this kind known as the Kroger gravity switch which has been in use on the road at Atlantic City, N. J., for the past five months during the winter, and has never failed to act promply, in all weathers.



THE KROGER GRAVITY TROLLEY SWITCH.

The Kroger gravity switch, shown in plan and elevation in the accompanying engravings, is composed of a box about 2 ft. 2 in. long and forms two channels, crossing each other at any desired angle. Each of these channels has a lock, both of which are fastened on one side, inside of the box and are shaped like a slanting letter T with the small or lower end fastened hinge-like in the roof of the channel, the hinge facing the approaching car. The lower edge of the lock forms likewise a guide for the trolley wheel, which in passing through the switch raises the lock and, after passing it, locks itself firmly against the opposite trolley wheel on the other line wire. In order to avoid the up-thrown lock when a car passes from touching the over-head wire, the upper edge of the lock has a notch in it. The outside box has a

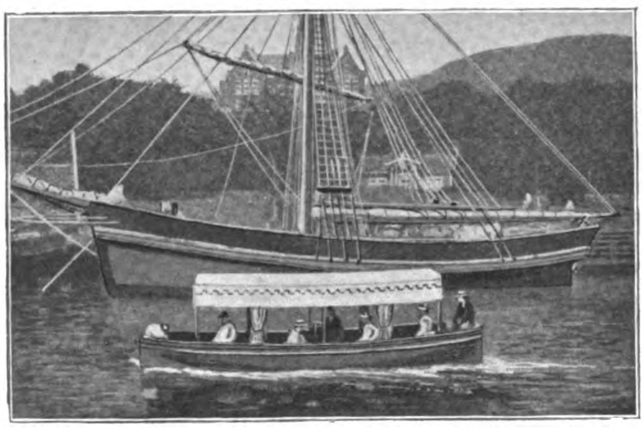
two-inch downward curve in the middle and on the top of which is the main fastening of the switch to the overhead wire. This switch can be used at any angle, no matter how sharp it is. The switch is perfectly automatic in its action and Mr. W. K. McAlister, general foreman of cars on the Atlantic City electric road, speaks of it in the highest terms.

WASHINGTON-BALTIMORE ELECTRIC LINE.

The engineer's estimates show that the Washington-Baltimore electric line will cost about $1,000,000 complete, including power houses at Washington, Laurel, and Baltimore, and track laid with eighty-pound steel rails, on hard-wood ties and rock ballasted. The overhead trolley system will be used. Work has already begun on the first five miles from Baltimore, for which contracts have been let; also on the power house of the Baltimore division. Among those interested are B. N. Baker, President of the Atlantic Transport Line; John Hubner of the American Banking and Trust Company, and David M. Newbold of Baltimore.

ELECTRIC FERRY BOATS IN BERGEN, NORWAY.

The city of Bergen which is the centre of the Norwegian land and sea commerce, ranges on two sides of a narrow harbor forming an inlet and surrounded by rapidly rising ground. The desire for rapid transit from one part of the city to the other across the narrow harbor resulted in the establishment last August of a line of electric ferry boats, under the management of Mr. J. Trumpy,

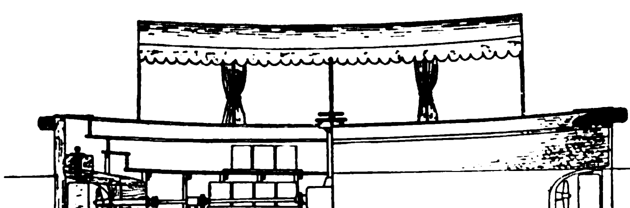


Electric Launch Ferry Service, Bergen, Norway.

who describes the methods employed, in the current issue of the *Elektrotechnische Zeitschrift,* of Berlin. Eight boats are employed in this service, a general view of one of which is shown in Fig. 1, and a longitudinal sectional view in Fig. 2. The dimensions of these boats are as follows:—Greatest length, 25 ft.; width of beam, 6 ft. 8 in.; depth, about 32 in.; number of passengers, 18; displacement, 6 tons.

Owing to the narrowness of the harbor, which averages about 330 yards, it became desirable to construct the boats so that they could operate without turning about to go from one station to another, and this was accomplished by making them double enders, with two screws, one at each end, both connected directly to the motor shaft. The motor weighs 660 lbs., and is of three horse power capacity.

The accumulators employed are of the Hagen type. Thirty-



Electric Ferry Launch, Bergen, Norway.

two cells are employed in each boat, weighing 5,280 lbs. The regulation of the speed of the motor is effected by cutting in or out the magnetic coils on the series wound motor. The average speed of the boats is about 7 ft. 6 in. per second, with an expenditure of twenty-three hundred watts. This comparatively low speed has been quite sufficient for the short lengths of the ferry routes, the shortest of which is 308 yards and the longest 680 yards. Besides, it is a safeguard against accident, which would be likely to ensue with a higher speed in the narrow harbor, which is usually considerably crowded with shipping.

The service during the winter months begins at 7 A. M. and ends at 9.30 P. M., on a five minute schedule. During the summer the time is correspondingly longer. Each boat covers 37 miles daily, and the average number of passengers carried up to date has been 1,800 per day. The charging station is run by a thirty horse power dynamo plant. The following are the costs of this installation.

8 boats, with duplicate parts	50,000 marks.
Charging station, ferry landings	40,000 marks.
Total	90,000 marks.

During the eight months of uninterrupted operation the installation has given the utmost satisfaction.

PERMIT VOTED TO THE STATEN ISLAND MIDLAND TO USE THE TROLLEY.

At a meeting of the State Board of Railroad Commissioners application was made in behalf of the Staten Island Midland Railroad for leave to use the trolley system on a part of its line. It was requested that the trolley might be used for the present on Oak street, from the intersection of Richmond Road to the Clove Road, and thence along the Clove Road to the Richmond Turnpike. The board entered an order granting the request, there being no opposition.

A TROLLEY ZOOLOGICAL GARDENS.

After a winter suspension of operations for five months the Ringing Rocks Electric Railway Company, Pottsville, Pa., has resumed its trips to the Ringing Rocks Park, three miles north of that city, a resort famous for its natural deposit of stones producing bell-like tones and for its picturesque scenery. The company has already placed in the park bears and alligators and proposes to have there a zoological garden. A switchback 400 feet long will be constructed and other attractions added. J. W. Spicer, of Baltimore, has been chosen superintendent of the road.

Letters to the Editor.

CURRENT, NOT VOLTAGE, KILLS.

It has been frequently pointed out that it is *current*, and not *voltage*, that kills, and that the human body is not at all like a voltmeter, or other device of constant resistance, which can always be placed across the terminals of the circuit for which it is intended. If we should attempt to name a voltage that is capable of being handled at all times, by all persons, and under all circumstances with impunity, we would be compelled to make it very low indeed. The writer would not dare place it above 50 volts, and deaths have actually occurred from contact with 50 volt circuits, although probably from leakage currents.

On the other hand many persons have received shocks from contact with circuits of several thousand volts without injury, and D'Arsonval cites the case of a man subjected to an E. M. F. of 2,000 volts for several minutes without any disagreeable results to speak of, beyond temporary unconsciousness. Of course, the reason for this great discrepancy is that the resistance of the body changes enormously under different conditions of contact. It is also exceedingly likely that different conditions of health in an individual render him at one time more likely to succumb to electric shock, than at others. The writer is also convinced that deaths of persons shocked by electricity have been the result of fright and superstition. Recently a coachman was shocked from a 104-volt circuit and, although he was entirely uninjured, it took several hours, and many persons, to convince him that he would not die. Pale and trembling he expected each moment to be attacked by convulsions and other symptoms of the *poison* with which he apparently considered himself inoculated.

In the case mentioned by Mr. W. J. E. Carr in the Engineer of April 24, I would be inclined to believe that the man died from the cause just mentioned, for Mr. Carr distinctly states that the autopsy showed no signs of bursted blood vessels or other symptoms that usually result from such experience. Had the examination showed otherwise, I would think that the man was either in wet boots, or attempted to open the circuit through his body and thereby subjected himself to the E. M. F. of self-induction of the circuit, which might be much higher than the working voltage

Arthur J. Farnsworth.

Mamaroneck, N. Y.

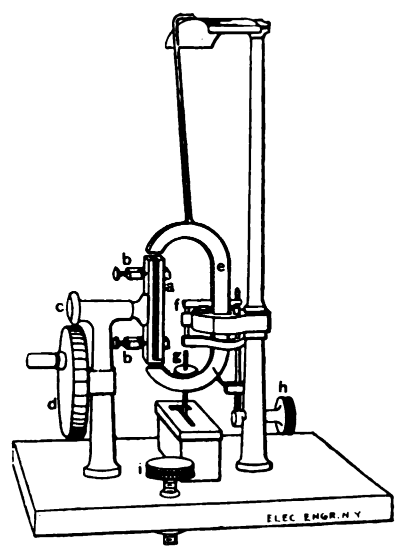
A MAGNETIC TESTER FOR MEASURING HYSTERESIS IN SHEET IRON.[1]

BY PROF. EWING, F.R.S.

Makers of transformers are now generally alive to the paramount importance, from the point of view of all-day efficiency, of using iron in which the hysteresis losses are small. The need, however, is felt of some simple means by which this qualtity can be readily determined. To make this possible, a simple and expeditious method of testing is imperative. The ballistic method, although unimpeachable on the score of accuracy, is anything but expeditious, and can scarcely be called simple.

The figure is a drawing of an instrument, the form of which has been reached after a good deal of experiment. The iron to be tested is cut or stamped in the form of strips, which are 3 in. long and five-eighths of an inch wide in this instance. The number of these pieces that is taken to compose the sample depends on the thickness of the sheet; six or seven pieces will in general be sufficient for the usual gauges of transformer iron, and a smaller number if the material tested is the thicker sheet used in dynamo armatures. The bundle of pieces forming the sample is placed in a carrier, *a*, and is covered with a vulcanite washer and secured by two clamps, *b b*. The carrier is made to rotate by means of the friction pulley, *c*, and driving wheel, *d*. This causes the sample to revolve between the poles of the permanent magnet, *e*, with the effect that its magnetism is periodically reversed. The work done in reversing the magnetism, in consequence of hysteresis, causes a mechanical moment to be exerted by the revolving sample upon the magnet; and the magnet, being supported on a knife-edge at *f* in line with the axis of the carrier, tends to follow the sample and is deflected through an angle which serves to measure the work expended.

Since a definite amount of work is done per reversal, whatever the frequency (so long as that is not so high as to make a sensible addition to the work by inducing currents), the deflection of the field magnet is independent of the speed at which the carrier revolves, and no special care has to be taken to turn the handle at a uniform rate. If the rate is very slow the magnet will show each individual impulse which it receives as the ends of the sample pass its poles, but when the speed is sufficiently raised these impulses blend into a steady deflection; and the speed may be further augmented to the extent of doubling it, or more, without making the deflection change. It is only at higher speeds still that the effects of induced currents become apparent. The deflection is observed by means of a pointer and scale above the magnet. The swinging of the magnet is checked by means of a dash-pot below, consisting of a vane, or spade, moving in a box filled with oil. The stability is adjusted to give any required degree of sensitiveness, by means of the weight *g*, which travels as a nut upon



EWING'S HYSTERESIS MEASURER.

a screw fixed to the magnet, and serves to raise or lower the center of gravity of the oscillating system. The magnet swings about a knife-edge working in an agate trough, and a lifting arrangement like that of a balance is provided, operated by the handle *h* to save the knife-edge from unnecessary wear or injury. The pointer is set to zero in the middle of the scale by means of a nut which runs on a screw projecting sideways from the middle of the magnet, and a more delicate adjustment of the zero may be effected by means of the levelling screw *i*.

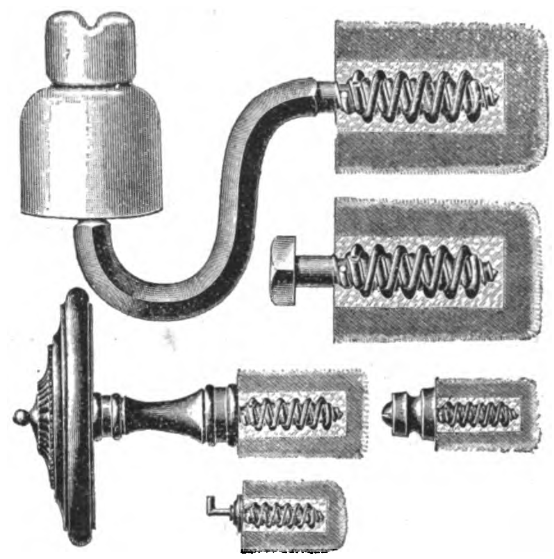
In operating, the observer inserts the sample and secures it by the clamps, then begins to turn the handle and lets the magnet down on its knife-edge. After reading the deflection of the pointer to one side he reverses the direction of rotation, reads the deflection to the other side, and takes the sum of the two readings as the total deflection. The deflection is proportional, or very approximately proportional, to the hysteresis of the iron, even when samples widely different in quality are compared.

The dimensions and strength of the field-magnet are so proportioned, with reference to the section of the sample and to the extent of the air gaps, as to make the induction have a value fairly representative of transformer work. In the instrument shown, the induction is about 4,000 C.G.S. units with the normal size of test sample.

1. Abstract of a paper read before the Institution of Electrical Engineers, London, April 25, 1895.

THE BOEDDINGHAUS SPIRAL WALL SOCKET.

HERETOFORE when brackets or other fittings have been fixed to brick or plaster walls, it has been necessary to drill a hole in the wall with a chisel, plug this with wood and then use the



BOEDDINGHAUS SPIRAL WALL SOCKET.

latter as the support for the object intended to be fixed to the wall. JuliusB oeddinghaus, of Dusseldorf, Germany, has recently brought out a novel device for the ready adjustment of brackets of all descriptions, which will be readily understood from the accompanying illustrations. As will be seen it consists in embedding in the wall, while the plaster is being applied, a metal spiral. When the wall is finished the spiral is firmly held in position and can easily be cleaned out. It then forms a socket into which the bracket can be readily screwed and held firmly. The device not only saves time but does not ruin the walls, carpets or ceilings, while at the same time offering an absolutely rigid hold for the bracket or other device. It naturally also allows of a ready removal of the bracket.

THE PROPOSED MILWAUKEE MUNICIPAL ELECTRIC LIGHT PLANT.

Mr. Benzenberg, the city engineer of Milwaukee, is going ahead with the plans and estimates for the municipal electric lighting plant just as if it were a sure thing that the city is going to quit the Badger Illuminating Company and have its own plant. Mr. Benzenberg is pretty well settled upon the kind of plant which he calculates will be erected on Jones Island. What is bothering him now is the distribution of the lights and the most economical way of laying the wires. It was all very well when the city forced private companies to put wires underground, but now it is getting a dose of its own medicine. Mr. Benzenberg expects to try a 100-light circuit. His plan is to run main feeders to each section of the city from Jones Island. Armored cables will be laid under the river. From the mains short lines will extend to the neighboring streets. In order to get the price of the plant within a reasonable figure Mr. Benzenberg calculates on putting wires underground only in the business section. Overhead wires will be put up in the residence sections of the city.

The contract of the city of Milwaukee with the Badger Illuminating Company for lighting the streets of the city will expire in the fall of 1895.

THE USE OF ELECTRICITY FOR COOKING AND HEATING.

In a paper read before the Society of Arts on April 24, on the above subject Mr. R. E. Crompton described the apparatus built by his firm involving some novel methods of manufacture, as follows:

After a long course of experiments we found that several of the nickel steel alloys, varying in composition from pure nickel to others containing quite a large proportion of steel, were well suited for the purpose, and in all respects were far superior to the German silver alloys which had been used in America. We use an enamel consisting almost entirely of silica for the groundwork; this fuses only at an exceedingly high temperature almost approaching the welding point of wrought iron. We devised special machinery to artificially roughen the surface of the plates to which this first coat of enamel is to be applied, and we thus insure that the layer of enamel between the wire and the plate, to which it is attached, is never even softened at the temperatures reached by our apparatus in ordinary working. We apply our nickel steel wire in the form of a waved or crimped ribbon.

This crimped ribbon is mounted on the surface of a "transfer plate," and it is from it transferred to the surface of the first coat of enamel, which has been already raised to a temperature sufficient to soften it but not to melt it. We then cover the first enamel and the wire with powdered enamel of a more easily fusible nature, and we then raise the temperature of the whole to a sufficient degree to enable the second enamel to melt down and incorporate itself with the upper surface of the first coat of enamel, at the same time completely covering and insulating our wires.

The following four tables give a fair idea of the cost of heating of surfaces required, first for roasting, or baking, or frying; the second table gives the cost of heating surfaces to a lower temperature, such as is required for warming the air of a room, or for airing linen, or similar purposes. Tables III. and IV. give the cost of the energy required for boiling water in small quantities, and are interesting, as they show that even when we are using electricity in the manner in which it compares least favorably

TABLE I.—*Showing energy required to raise a heater plate from 50° F. to 400° F. in half an hour.*

Time.	Energy in B. O. T. units. 1000 watt hours.	Cost at 4d. per unit.	Temperature, Fah. scale.
0	0	0	50deg.
10min.	0.116	0.46d.	257deg.
14min.	0.161	0.67d.	332deg.
21min.	0.248	1.0d.	357deg.
30min.	0.404	1.61d.	400deg.

TABLE II.—*Shows the energy required for a radiator plate, such as we use for heating the air of a room.*

Time.	Energy in B. O. T. units.	Cost at 4d. per unit.	Temperature, Fah. scale.
0	0	0	50deg.
10min.	0.091	0.364d.	171deg.
30min.	0.277	1.1d.	240deg.
40min.	0.350	1.4d.	257deg.
50min.	0.430	1.72d.	261deg.
60min.	0.500	2.0d.	264deg.

TABLE III.—*Shows the energy required for boiling 1lb. of water in a tea-table kettle.*

Time.	Energy in B. O. T. units.	Cost at 4d. per unit.	Temperature, Fah. scale.
0	0	0	50deg.
10min.	0.075	0.3d.	212deg.

TABLE IV.—*Shows energy required by a smaller kettle containing ¾lb. of water*, i. e., *sufficient for two cups of tea.*

Time.	Energy in B. O. T. units.	Cost at 4d. per unit.	Temperature. Fah. scale.
0	0	0	50deg.
12min.	0.051	0.2d	212deg.

with solid fuel, *i. e.*, for the boiling of water, we can, with an ordinary electrical kettle, switch on the current and obtain a cup of tea at a cost of less than a farthing for a single cup, or half a farthing per cup, if several are required.

Now that we can actually measure the heat that is required, and carry on cooking operations, we are astonished at the smallness of the results obtained by present methods. The percentage of the heat units of the coal burnt in our kitchens which is actually utilized in cooking the food is in all private houses, and in most hotels and clubs, so ridiculously small that I should hardly be believed if I quoted you the figures which we have obtained; it is not too much to say that in many cases not more than 2 per cent. is utilized.

WIRING TABLE FOR MOTORS.

The following table for wiring for motors of from ⅛ to 7½ H. P. on 110 and 220 volt circuits has been calculated by Mr. S. L. Barriett, and is based on the rules of the Fire Underwriters and has the sanction of the Edison Electric Illuminating Co., of New York. All the wires are calculated for a 3 volt loss.

BARRIETT WIRING TABLE FOR MOTORS FROM ⅛ TO 7½ H. P. ON 110 AND 220 VOLT CIRCUITS. BASIS THREE VOLT LOSS.

Horse Power.	Voltage.	Distance in Feet to Motor.													
		20 ft.	30 ft.	40 ft.	50 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.	120 ft.	140 ft.	160 ft.	180 ft.	200 ft.
		Sizes of Wire, B. & S. Guage.													
⅛	110	14	14	14	14	14	14	14	14	14	14	14	13	13	12
	220	14	14	14	14	14	14	14	14	14	14	14	14	14	14
1	110	14	14	14	14	14	14	13	13	12	11	11	10	10	9
	220	14	14	14	14	14	14	14	14	14	14	14	13	13	12
2	110	10	10	10	10	10	10	10	10	9	9	8	7	7	6
	220	14	14	14	14	14	14	13	13	12	11	11	10	10	9
3	110	8	8	8	8	8	8	8	8	8	7	6	5	5	4
	220	12	12	12	12	12	12	11	11	10	10	9	9	8	7
5	110	5	5	5	5	5	5	5	5	5	5	4	3	3	2
	220	10	10	10	10	10	10	9	9	8	7	7	6	6	5
7½	110	3	3	3	3	3	3	3	3	3	3	2	1	1	0
	220	7	7	7	7	7	7	7	7	6	6	5	4	4	3

AN ELECTRIC GOLD DREDGING PLANT IN NEW ZEALAND.

An interesting account was given recently by Mr. Robert Hay, of the application of water power in producing electricity for use in gold dredging in Shotover River, New Zealand. The water is obtained at a creek 1½ miles distant from the dredging ground, and brought by a race cut in the side of the hill, or, in places where the ground is not suitable, in a timber flume to a pressure tank at a level of 524 ft. above the pipes at the generator house. From this tank to the Pelton wheel the water is carried in rolled steel pipes, constructed in lenghs 19 ft. 6 ins. bolted together by wrought iron flanges riveted to the pipes.

The prime mover of the generating plant is a 4 ft. Pelton reaction water wheel, upon the buckets of which the water, from a nozzle 1½ in. in diameter, impinges at a pressure of 228 lbs. per square inch. This wheel drives two series-wound dynamos working at a normal speed of 700 revolutions per minute, each developing a current of 40 amperes, at an E. M. F. of 650 volts, or nearly 70 H. P. The dynamos are coupled in series. The conductors, of a length of two miles, are of No. 4 S. W. G. bare copper wire, and are supported upon insulators carried by cross-arms upon old 40-lb. rails.

The current is conducted to two motors in the dredge, one for driving a centrifugal pump and the other for operating the buckets, winches and revolving cylinder. These two machines are duplicates of the dynamos, and are coupled in series, so that when the bucket-motor is switched off, the pump motor absorbs the surplus power by increasing the speed of the pump, and causing it to throw more water.

The dredge is constructed for the most part of steel, and is capable, when operating at a depth of 20 ft., of an output of 90 cub. yds. per hour. The dredgings are delivered through a revolving screen, for separating the stones and coarser material, upon baize tables set at an inclination of 1 in 12. Two 10 ampere arc lamps light the dredge at night, and are joined in multiple series with the motors, with suitable arrangements for their control. The cost of the installation and the weekly working expenses are $35,000 and $175 respectively.

The City of Boston, according to the annual report of its Lamp Department for 1894, has in street use 2,358 arcs of 2,000 c. p., furnished by three companies, and of Brush and Thomson-Houston make. Ten years ago there were less than 500. Nearly 800 were added last year.

THE ELECTROLYSIS OF GOLD.[1]

BY DR. N. S. KEITH.

The author gives an account of the methods now in vogue of reducing gold by the action of successive quantities of cyanide of potassium and as a result of his studies and experiments he some time ago came to the conclusion that the action of oxygen was due to its strong electro-negative relation to gold in the cyanide solution. He has also discovered that mercury is electro-negative to gold in such a solution. Based on these discoveries he has devised the following process for electrolytically obtaining gold and silver from auriferous and argentiferous rocks and ores:

Sufficient solution of cyanide of potassium, of a strength varying from 2 to 10 lbs. of cyanide to each ton of water, with from 2 to 10 oz. of a soluble salt of mercury, is prepared. The finely pulverized ores, or tailings, are submitted to the leaching process with this solution, as in the other cyanide processes. The electro-positive gold in the tailings decomposes the mercury salt which comes in contact with it, and thereby produces voltaic couples of mercury and the minute particles of gold, thus hastening the dissolving of the gold.

As the solutions come from the leaching vats they are run continuously through electrolytic precipitating, or depositing, vats, constituted as follows:—Long boxes are provided, say, a little over 2 feet deep and 2 feet wide, containing copper plates 24 inches square, and crossing the boxes every 1½ to 2 inches, but placed so that every alternate plate rests on the bottom and sides of the boxes, and the intermediate plates are raised about half an inch above the bottom of the box.

On the average basis of a density of current of 0·06 ampere per square foot, a cathode surface of 800 square feet is ample for a plant treating 3,000 tons of average tailings per month. One hundred plates of the size named supply this amount of surface. These plates are preliminarily amalgamated with mercury, and are each connected with a 'bus-bar which is connected with the negative pole of the source of electricity. Between these cathodes are placed porous cells filled with a half-saturated, or other strength, aqueous solution of an ammonium salt, such as the chloride or sulphate. Into each cell is placed a rod, strip, or prism of zinc or iron, and each of these is connected by wire to another 'bus-bar, which is connected with the positive pole of the source of electricity.

Because the gold is deposited in exceedingly attenuated particles, the amount of mercury necessary to form with it a plastic amalgam is much in excess of the quantity of gold—say three or four times as much. This relation varies with the rate of deposition of gold.

Because the anode is rendered soluble by putting it in a suitable electrolyte there is no consumption of energy in the actions which there take place. There is no escape of uncombined or free oxygen. A zinc anode is electro-positive to the mercury cathode to the extent of 0·25 volt—in itself sufficient to cause the deposit. When the anode-electrolyte has become exhausted as an electrolyte by the formation of double salts with the metal of the anode, the porous pots have their liquid contents removed and new electrolyte substituted therefor. Porous pots are used an inch or so in diameter and 24 inches deep; eight or ten in each space between the cathodes are sufficient.

The cathode, though in its substance mainly of copper, is, electrically, a mercury one; therefore, not as strongly electro-positive in its electrolyte as is a copper one. But the anode is sufficiently electro-positive to it to keep the cyanide solution from dissolving the gold and mercury when the dynamo, or other source of electricity, is unconnected, provided the anode and cathode be connected electrically.

The depositing vat can be, and is preferably, worked continuously. The anode parts are supplied from time to time as fast as dissolved. The anode-electrolyte is renewed from time to time, as necessary, by the use of a hand pump. The amalgam is removed whenever desired from the cathode plates.

The amalgam is "retorted," as in the usual routine of gold amalgamation—a much simpler and less expensive operation than melting and cupelling. Practically no mercury is lost. The electromotive force necessary to carry out this process does not exceed one-half volt.

The author quotes figures showing the cost of electrolyte gold production by the Siemens & Halske porcess and claims that his method effects a considerable saving in cost.

A TEXAS ELECTRICAL EXPOSITION AND REGATTA.

An international regatta and electrical exposition will be held at Austin, Texas, next June. The electrical exposition will be free to every manufacturer who desires to exhibit his machinery. The motive power will be furnished free. The exposition is to celebrate the completion of Austin's dam and water and electric light plant at a cost of $1,250,000.

1. Abstract of a paper read before the London Institution of Electrical Engineers.

LITERATURE.

Elasticity as a Mode of Motion. By Robert Stevenson, C. E., M.E. Industrial Publishing Co. San Francisco, 1895. 61 pp. Paper. Price, 50 cents.

Herrman von Helmholtz. A memorial address delivered in the Singakademie, Berlin, Dec. 14, 1894. By Wilhelm von Bezold. With photogravure portrait. Leipzig, 1895. J. A. Barth.

Die Elektrotechnik auf der Weltausstellung in Chicago. By Dr. Johann Sahulka. Vienna, 1895. The Imperial-Royal Commission.

This constitutes Part IX. of the Austro-Hungarian World's Fair Commission. Dr. Sahulka has given a most intelligent and, within the limits of the space at his command, comprehensive account of the electrical features at the Chicago Exhibition.

ELECTRICAL ENGINEERS IN THE CIVIL SERVICE.

The subjoined dispatch from Washington, D. C., is evidently written by somebody who supposes that an electrical engineer is a kind of mechanic:—An effort is being made by the Civil-Service Commission to extend the protection of the classified service over the steam and electrical engineers employed in the departments. The civil service law provides that laborers and workmen shall not be included in the classified service, but in a parenthesis explains that this is not to be taken to refer to skilled laborers or workmen. Although all classes of mechanics, including carpenters, engineers, electricians, and the like, may thus be included in the operation of the law, a distinction has always been made between the appointments to classes of workmen whose neglect of duty might cause danger or death and those on whom no such responsibility can fall. Carpenters and model repairers are subject to competitive examinations, while engineers, though required to prove their ability and skill, are not subject to it. Their personal habits and general reliability have been considered to be the first question and their relative skill the second. The Civil-Service Commission thinks itself quite competent to insist on these primary qualifications, and, at the unanimous request of the engineers themselves, has asked the President to extend the competitive system to them.

A MADAGASCAR CABLE.

The Anglo-American Telegraph Company of London, has completed the laying of a cable from Mozambique to Majunga, on the island of Madagascar, which is now open for business. The rate per word from London to Majunga (which is the only office) is $2.72. All telegrams must be written in plain language in either English, French, or Portuguese. Messages will be subject to censorship at Majunga.

A RAPID FIRE ELECTRIC GUN.

An electric gun has been invented by A. S. Krotz, electrician of the Springfield Street Railway. It is simply a brass tube, open at both ends, around which is wrapped insulated wire, in a series of helices from one end to the other, acting upon iron balls put in at one end of the tube and passing through with ever increasing impetus.

The special advantages claimed for the gun are that it may be made very light in proportion to its capacity for throwing balls; that it can not possibly explode; that it is economical in operation, and that the limit of the number of balls it will throw within a given time is the number of balls that can be put into its breech. For field service it is claimed it will far surpass anything now in use. The inventor estimates that from seven hundred to one thousand shots per minute can be fired. Tests have been already made that are said to have been highly successful.

THE BALTIMORE SUBWAY CONTRACTS.

The Baltimore Subway Committee has awarded the contract, for the cable and electrical connections, terminals, test boards, etc., to the Western Electric Company. The bids were submitted for cable at so much per foot, and the fixtures were bid on by the unit. The Western Electric Company were not the lowest bidders, the estimate made on their figures for the cost of the work, being about $36,000. The other bidders were the Standard Underground Cable Company, and John A. Roebling's Sons Company. The Standard Underground Company were the lowest bidders by about two thousand dollars.

THE

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CONTENTS.

THE ELECTRICAL BANE AND ANTIDOTE.

THE National Board of Fire Underwriters has again held its annual meeting in New York City, and we are glad to find that in the fire insurance field as in others, there are bursts of sunshine and signs of recovery. President Walton, in his address, does not hesitate to say that "the year 1894 shows a marked contrast with its predecessor and the results as a whole have been generally gratifying." The percentage of dividends paid in 1894 was, he reports, 9.82 against 9.58 in 1893. It is $\frac{7}{100}$ of 1 per cent. below the average of 10.52 since 1860. From 1890 to 1894 the average loss ratio of all companies rapidly increased, rising in 1893 to 66.93, the highest point since the years of the Chicago and Boston fires. While still high for the year 1894, and above the average for the whole period, it yet fell to 59.99, showing an improvement of 6.94 over the previous year.

This gain is encouraging and, of course, would indicate more than might be perceived superficially, for it is an unfortunate accompaniment of bad years such as 1892–4 that fire losses increase. It shows also that electricity is not the evil that underwriters have often been hasty in assuming. Mr. Walton in wisely urging uniformity of requirements for wiring refers to electricity as "this hazard which it is believed has so largely increased the fire risk." Speaking of the work of the Committee on Lighting & Heating he says :—"Its success in securing practically uniform rules throughout the United States, designed to insure greater safety in the use of electricity for light or power, is an important step which should be appreciated alike by the underwriters and the general public. Now that this has been accomplished it is to be hoped that local Boards and underwriting associations will not depart from the standard regulations thus adopted." Rules are of no use unless standardized and then lived up to.

We trust that Mr. Walton's appeal for uniformity in wiring regulations will meet with a response, in electrical not less than in insurance circles; but it seems to us appropriate to interject the remark that our insurance friends are far too apt to treat electricity as a bane, forgetting that it is also an antidote. If due investigation be made, it will be found that the reduction of fire loss is and must be attributable to the introduction and maintenance of efficient fire alarm systems; and that the loss is further reduced by the auxiliary systems that ensure the protection of separate buildings or machinery. Indeed, it often strikes us that insurance companies are not as quick as they might be to recognize and patronize many of the later ingenious inventions that aim at giving an alarm when the danger point of heat is reached. The Boston papers, for instance, reported the other day—May 8—the destruction of a large steam mill in Vermont by a fire originating in a hot box. Yet there are devices on the market to guard against just such an occurrence from hot journal bearings, by giving instantaneous alarm; and it would appear to be the part of insurance economy to encourage such antidotes by making a reduction in premiums wherever they or kindred electrical appliances are used. Of course, this is now done to some extent, as with thermostatic alarm and sprinkling systems, but it does not go far enough, and the inducement should be made more solid and tangible.

A GOOD TIME TO BUY WIRE.

The renewal of business activity is bringing with it many changed conditions in the electrical field, and one of these is the hardening of prices for material. Copper, in particular, is lively, and there are not wanting indications that, from both natural and artificial causes, it may advance considerably. In fact, it has begun to do so. We would suggest to our central station and railway friends—to all, in short, who have to buy insulated wire,—that the present time is about as good for placing orders as any they are likely to see in a long while. Several of the factories are now busy, but they will be busier, and on that ground alone will have to raise price at no distant date. But with copper going up, prices are higher even now, and any one who has machines to build or circuits to run this year will do well to protect himself against a higher market.

"INDEPENDENT" TELEPHONIC ACTIVITY.

The independent telephone companies and interests are manifesting a good deal of activity these early summer days. Our pages week by week bear testimony to the alacrity with which local capital and local energy are being applied to the new work. Exact statistics are not likely to be obtainable for some time to come as to the investment in the industry, outside the Bell exchanges, but it is obvious that several million dollars are already pledged, while probably one or two millions at least have already been spent. That this is so is shown by the fact that the Harrison system is reported in use at over 150 exchanges, with a parent organization in 31 States. The Western Telephone Construction Company has also a list of two score exchanges; and this by no means exhausts the roll call of independent "centrals." Moreover, no one can keep track of the isolated interior work. Telephones are being installed by the cartload in every part of the Union; and even should the Berliner decision be reversed, it would be a herculean task to get matters back to the old condition, and all the new apparatus out of the way. On the contrary, it would appear that the telephonic outbreak is not yet by any means at its height. The public are the gainers, but it is to be regretted that better prices have not been secured on the apparatus, in many instances. Now is the heyday of opportunity, but no opportunity is golden for apparatus sold below cost.

A FAN MOTOR EPISODE.

The uses of the fan motor are various, and often of an unexpected nature. The writer visited a factory recently where huge vats simmered, but the coolest man around was the attendant who, standing right over them, was briskly blown upon by a sturdy little fan motor. This, however, is commonplace compared with the experience of a family in the country, who were about to lose their cook, a genuine cordon bleu, because the kitchen was too hot. In despair they consulted a friendly electrician, who finding that an alternating circuit ran near by, promptly made a tap and fixed up a little fan motor. It worked like a charm. The motor blew, and the cordon bleu, exclaiming that she had never been so comfortable in a kitchen before, vows that she will never leave—except to go to some other kitchen where a fan motor can be found. It seems to us that much family peace not now known could be secured in hot summer days, when parlor and kitchen alike are fretful under the old fashioned conditions, and where a soft breeze would turn away the wrath of both the mistress and the hired help.

PATENTING SERIES PARALLEL MOTOR CONTROL.

A recent opinion filed by the Examiner of Interferences in the Patent Office seems to us worthy of attention, not only in its bearing upon the matter directly in controversy, but also in its broader aspects as affecting similar claims of patentees. The case in question is the result of an interference declared between Dr. John Hopkinson and Rudolph M. Hunter and involving the series parallel coupling of electric railway motors. The claim in controversy reads as follows:

> "The combination of an electrically propelled vehicle having two electric motors, a source of electric supply and switches for coupling up the motors in series or multiple with the source of supply to vary the speed or power of the motors."

This broad claim is embodied in Hunter's patent entitled "Electric Railway," filed February 24, and issued June 26, 1888. On July 28, 1892, Dr. John Hopkinson filed a patent embodying the same claim, which puts him in interference with Hunter. In seeking to establish his title to priority Dr. Hopkinson cites his British patent, issued January 7, 1882. Hunter claimed that he had conceived the invention in controversy and made a sketch of it in January 1881, and that he reduced it to practice in the fall of 1887. In his opinion, the Examiner of Interferences draws attention to the fact that the testimony by Hunter to establish a date prior to that of Hopkinson's patent submitted a large number of sketches of embryo inventions, which had been cited by him in previous proceedings. None of them, however, gave any clear description of the invention. The Examiner does not consider that such general efforts as those detailed by Hunter, aimed to cover a multitude of inventions, can close the field as against other rival inventors, or that such testimony can be held to establish diligence as to the prosecution of any particular invention, not described in specific terms in the correspondence and disclosures, which were for the purpose of interesting capital and prosecuting inventions generally. He also cited the case of Hunter vs. Knight.—MS. C. D., Vol. 23, p. 124, which sustained him in holding that

> "An inventor must, like persons in the other vocations in life, elect from many enterprises with which he is confronted and pursue such of these as are most promising. It is not within the limits of human capacity to prosecute more than a given number of undertakings at one time and whenever it is attempted the result is the failure of them all or the dropping of some of them by the wayside."

While awarding Dr. Hopkinson the claim to priority, the examiner draws attention to the fact that the patent for which Dr. Hopkinson applied in the United States was in public use upon the Lehigh Avenue Railway, in Philadelphia, in the month of May, 1890, and hence comes under the law forbidding the issuance of a patent for an invention in use two years prior to the date of application therefor. From the opinion of the Patent Office examiner it would seem that the "Series Parallel" method of coupling street railway motors was public property.

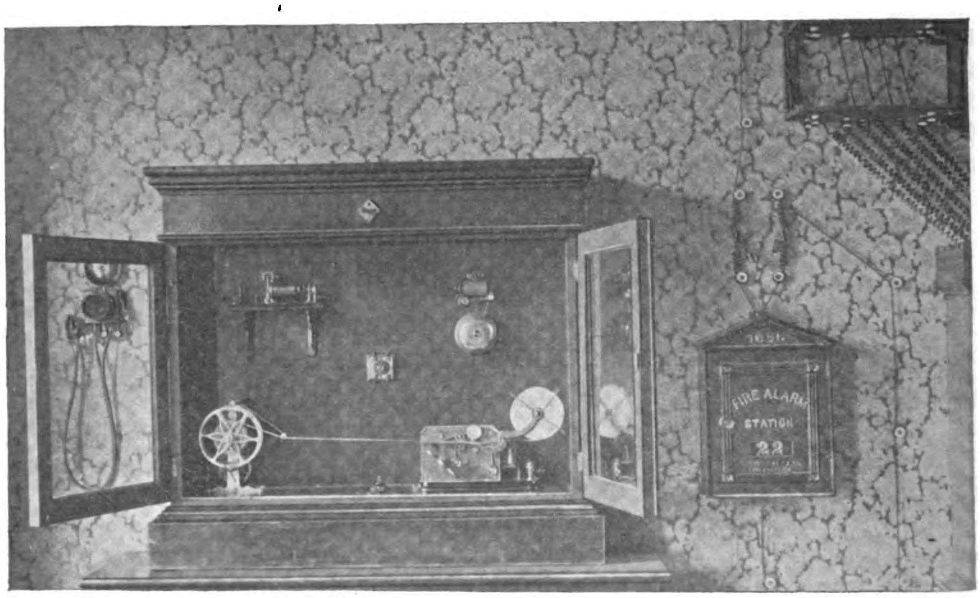
THE "UNIVERSAL" FIRE ALARM SYSTEM.

If it be considered that the fire loss in the United States during the last four years amounted to $550,000,000, no argument need be forthcoming to demonstrate the value of any device designed to mitigate this simply appalling state of affairs. It is not to be wondered at, therefore, that the underwriters are encouraging by all the means in their power the introduction of apparatus for

The Central Office Equipment—Universal Fire Alarm Co.

giving immediate notice of the outbreak of a fire especially such as are designed to extinguish it by the automatic operation of sprinklers.

It is a very simple matter to arrange a thermostat to close or open a circuit and give an alarm on an abnormal increase of temperature; but it is quite another to devise a system which



The "Universal" Fire Alarm Equipment at the Police or Fire Station.

shall continue in unfailing effective operation with the many disarrangements to which electric circuits are subject. It was with this object particularly in view that Mr. Louis G. Rowand, of Camden, N. J., designed the system described below, which is now being exploited by the Universal Fire Alarm Company, of 925 Chestnut St., Philadelphia.

The system is especially arranged to give an instant alarm of fire under various conditions of the circuits—some eighty-five in all. But, as an instance of the marvelous adaptability of the alarm, we need only cite the fact that a perfect alarm of fire can be, and is, given, with the main outside line broken, grounded and short-circuited; the main inside line broken and short-circuited, and the local or building line broken and short-circuited; or with any combination of any of these difficulties or disarrangements, whether they result from storms, accident or design.

Each thermostat is connected by a circuit with a fire alarm box and annunciator combined, placed in some frequented part of the building. The annunciator immediately upon the breaking out of a fire indicates the floor on which the fire is, by the ringing of a vibrating bell to notify the occupants that there is a fire on the premises, and at the same time gives notice to the nearest fire station, or the municipal fire head quarters, of the fire; exactly locating the threatened building at once by number and street.

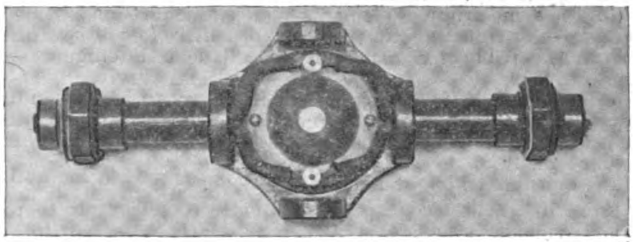
The annunciator is also so constructed that it gives instant notice at the central station only, of any disarrangement of the wires or thermostats. In such cases, the vibrating bell in the equipped building does not ring, and no unnecessary annoyance is caused. The vibrating bell referred to above rings only in case of a fire.

The thermostats are constructed of vulcabeston, and are

practically, as proved by test, fire-proof and water-proof.

The company, when wiring a building, treat it as an electric light installation, such as soldering all joints, placing all wires on porcelain insulators, and tubing the same through all floors, partitions, etc.

A valuable feature of this system is that the batteries are situated only in the central station, where they are under the continual care of the man in charge; no batteries being in any of the buildings connected, except those used simply for testing out any particular building. These are connected up in local circuits, being entirely independent of the main or working circuit. This method simplifies and increases the reliability of the system, as the man in charge of the station can give constant attention to the

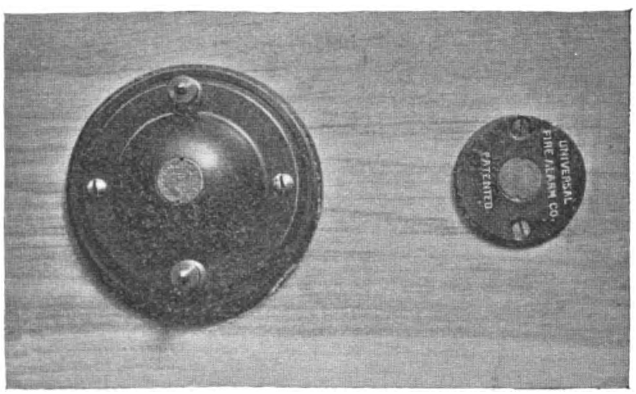


THE "UNIVERSAL" MARINE THERMOSTAT.

batteries, with a current indicator always in circuit indicating its condition.

The Universal Company has also adapted its apparatus to a marine system of fire protection, and the Old Dominion Line steamers "Jamestown" and "Yorktown" have been equipped with it.

While automatic sprinklers have done much to decrease the fire loss they have also introduced a new danger owing to the fact that sprinklers open accidentally, when no fire exists and the ruin by water has in many cases been quite as great as that which might have been caused by a fire. The Universal system, how-



THE "UNIVERSAL" OPEN AND CONCEALED WORK THERMOSTAT.

ever, is designed to take care of this danger also, so that the instant a sprinkler starts, an alarm is sent in whether there be a fire present or not.

In addition to their interior protective system the Universal Company also have a regular street alarm system based on the same principles and embodying like features of infallibility in operation.

THE BEANE ELECTRICAL STEERING INDICATOR.

It is understood that a new electrical invention, by Mr. Edmund M. Beane, of New York City, will shortly be introduced, which may have considerable influence on the art of navigation. The use of the apparatus is that it indicates constantly in all weathers the longitude, latitude and course of a vessel at sea, making its own correction for compass variations. Its operation is magnetic. Such an invention would appear to have in it elements of great value; and it is said that it might easily shorten the trip of a fast steamer between New York and Liverpool five hours and even ten by assisting in the maintenance of a straight course. It would also make possible the plan, rejected by the Marine Congress, at Washington, as impractical, to establish ocean paths for all vessels. Mr. Beane has enjoyed consultation with eminent scientists in the development of his invention.

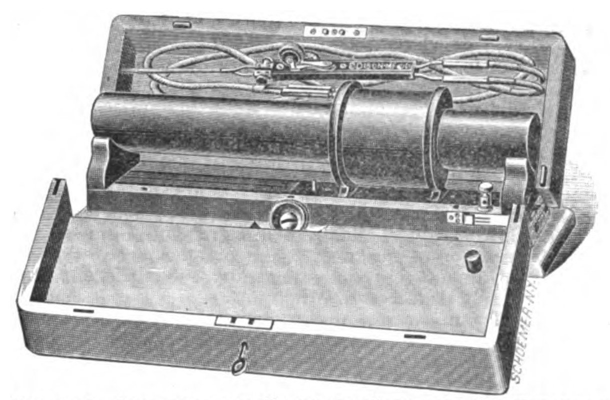
ELECTRIC BATHS FROM STREET CIRCUITS.

The employment of street lighting circuits for electric baths has become quite customary in France. A transformer is used which lowers the potential to from 15 volts to zero.

Where only a single bath is to be fitted up, as in a private residence, there is employed a combination in series of a shocking coil and a small transformer. The whole is placed in a little marble receptacle above the bath. The secondary of the transformer moves along slides, and a rod passing to the outside enables the current to be regulated from a maximum to a minimum strength. The primary circuit is provided with an interrupter. The wires of the secondary proceed directly to the electrodes, which are simple plates of metal that can be placed anywhere in the bath by means of suspending hooks. There is also added an amperemeter for continuous and alternating currents.

THE KENNELLY ALTERNATING CURRENT CAUTERY TRANSFORMER.

THE object of this small instrument is to enable physicians to use the 52-volt and 104-volt alternating current, for electro-cautery and diagnostic lamp purposes. The primary circuit is composed of a number of turns of fine insulated copper wire wound round a core of annealed iron wires, the whole being enclosed in a thin



KENNELLY ALTERNATING CURRENT CAUTERY TRANSFORMER.

cylindrical shell of hard rubber, which is supported by a hard rubber standard at each end. The secondary coil composed of a few turns of thick wire, is wound on a hollow hard rubber spool, moved by a rack and pinion motion and sliding over the primary coil. The terminals of the secondary coils are brought out to two pin attachments mounted on one head of the coil, and the cautery cords are connected thereto by split socket connections. On moving the secondary coil to the right, the current is increased, and vice-versa.

The apparatus is mounted in a highly polished mahogany box which opens down the middle, as shown in the cut, and is fitted with a switch at the side, which automatically cuts off the current when the lid is closed. It is provided with an attachment plug, and 10 feet of flexible cord for connecting the instrument to the mains. This instrument is manufactured by the Edison Manufacturing Company, No. 110 East 23rd Street, New York City.

AN ODD SCHEME FOR BUFFALO POWER.

A somewhat fantastic scheme is announced as under consideration in Buffalo. It is proposed to harness the Niagara River at Buffalo, and generate electric power instead of waiting for it to come from Niagara Falls. In the interest of this proposal a bill has been introduced in the Senate at Albany by Senator Persons of Erie County, on behalf of Senator Laury, who was detained at home in Buffalo. The object of the bill is set forth in its first section, which is as follows:—"Permission is hereby given to Alonzo C. Mather, a resident of the United States, to erect and maintain a bridge having power wheels connected therewith for developing the power of Niagara River at the City of Buffalo, said bridge to be constructed for the accommodation and use of pedestrians, passengers, and vehicles of all kinds, and other traffic across said Niagara River, between the United States and Canada, at such location as is best suited to the development of such water power at said City of Buffalo. Such permission is granted upon the following express conditions that an experimental span for the purpose of demonstrating the ability and practicability of said bridge be built, work upon said experimental span to be commenced within two years from the passage of this act and be completed within five years."

THE GENESIS OF THE AMERICAN ELECTRIC TELEGRAPH.[1]

BY FRANKLIN LEONARD POPE.

S. F. B. Morse.

Some years ago I was commissioned by the publishers of the *Century* Magazine to prepare a paper to be entitled "The American Inventors of the Telegraph." A large mass of original material was placed at my disposal, much of which had never been printed, comprising many letters of Morse, Alfred and George Vail, Smith, Kendall, and others identified with the early history of the American electric telegraph, together with a written statement by William Baxter, a well known inventor, now dead, who in his youth assisted Alfred Vail at Morristown in his work in developing the earliest apparatus. Much labor was devoted to a critical comparison of authorities, with a view of throwing some new light on certain long-vexed questions as to the real authorship of the American system of telegraphy. The results were embodied in an illustrated article, in the *Century* of April, 1888. My conclusions being in some respects widely at variance with those which had been accepted by preceding writers upon the history of the art, naturally gave rise to comment and criticism. In undertaking this commission, I had of course sought only to ascertain and state the exact truth, as it should appear after a critical examination of the most trustworthy source of evidence, the contemporaneous correspondence of the different persons most immediately concerned in the matter.

So far as I am aware, no serious attempt has been made to controvert the essential facts relied upon in forming the opinions set forth in the *Century* article—with possibly one exception, to which I shall further on take occasion to refer—but there has nevertheless arisen a difference of opinion in respect to the proper interpretation of those facts. It is no longer seriously disputed that the respective contributions of Henry, Vail, and Gale constitute essential factors in the organization of the modern telegraph, and that without the assistance of these scientists and inventors, it is by no means certain that success would have finally crowned the unwearied and persistent labors of Professor Morse. The real question at issue appears to me to be this:—To what extent ought we to accord to Morse the right to appropriate the results of the labors of his predecessors and of his assistants? And particularly ought we to inquire whether the important changes in the original scheme of Morse devised and introduced by Vail are rightfully to be regarded as mere improvements upon the prior invention of Morse, or as independent and original inventions.

Let us consider first what is the essential principle of the commercial telegraph of to-day? I conceive it to consist, *first*, in the coöperative assemblage of the following elemental parts: (1) a source tending to generate a continuous current of electricity; (2) a line of conductors extending to and returning from some distant point, traversed throughout its length by such current; (3) a device for alternately interrupting and restoring the continuity of said conductor at a given point at will, and (4) a means of rendering evident to the senses the presence or absence of a current in the line of conductors; and *second*, in a mode of operation which consists in interrupting and restoring the current in the conducting circuit in accordance with a pre-arranged code of elemental time-intervals, arbitrarily representing alphabetical characters.

When one skilled operator transmits a communication by manipulating the severed ends of a conducting wire in accordance with such an alphabetical code, and another skilled operator receives it by utilizing his tongue for detecting the flow and cessation of the electric current, we have the simplest possible embodiment of the primary concept of the generic invention.

But if we go a step further, and inquire what are the essential structural elements of the *commercial* telegraph of to-day, we at once perceive that these are likewise four in number, viz., (1) the generator; (2) the line; (3) the transmitting key; (4) the electro-magnet and its movable armature and (5) the automatically acting retractor for withdrawing this armature from the electro-magnet. But the structure alone is not enough; it must have in addition a method or law of operation, and this is supplied by the bi-signal alphabetical code founded on the immutable basis of time or space. Laying aside for the present all consideration of the actual historical evolution of the telegraph of to-day, it is self-evident that in its essence it comprises nothing more and nothing less than the application to a specific structural organization of a specific law of co-ordinate operation. Therefore, abstractly speaking, the true inventor of our generic telegraph must be he who first applied this particular law of operation to this particular assemblage of elements.

Without entering into a discussion of authorities, it may be sufficient for the present purpose to take the following statements for granted:

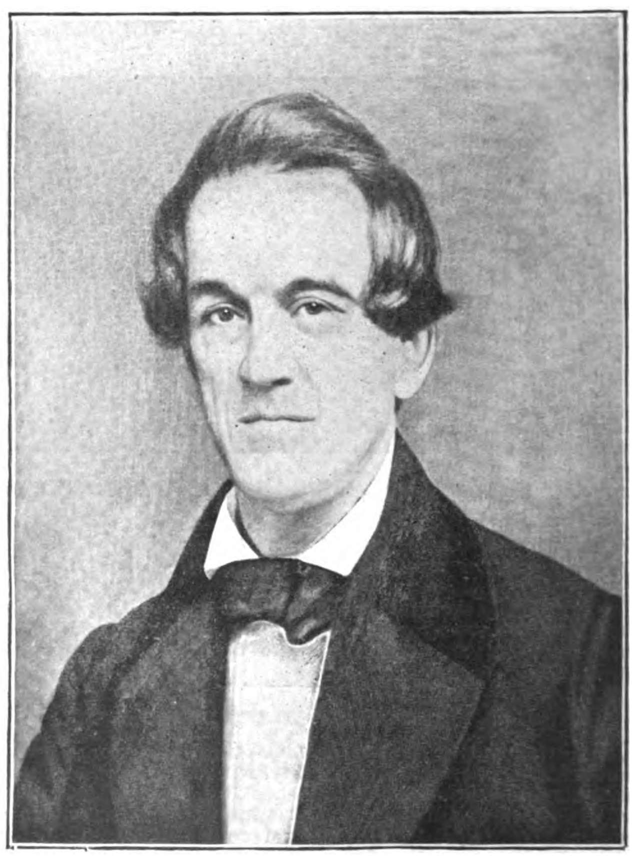
(*a*) A generator of electricity, a circuit-breaking key, a circuit of conductors, an electro magnet and an automatically retracted armature were first assembled together in a mutually dependent relation by Henry, in 1831.

(*b*) The same group of elements were a second time assembled together—this time under a specific *co-operative law of operation* so as to be capable of transmitting miscellaneous intelligence—by Morse, in 1836.

(*c*) The alphabetical bi-signal code appears to have been first applied to the above organization of elements, so as to constitute the generic modern telegraph, at a date between January 6 and January 24, 1838.

The question is, by whom was this done?

From his earliest conception of an electric telegraph, there is ample evidence that Morse had consistently adhered to one method of transmitting intelligence; that of indicating numbers by groups of impulses representing the nine digits and applying these numbers to the individual words of a dictionary. In his sketch-book of 1832 he jots down examples of this scheme, and in the *Morristown Journal*, there was published an account of the first public exhibition of the new telegraph on January 6, 1838, in which it is expressly stated that the communication was by numbered words in a dictionary. But the *Journal of Commerce* of January 29, 1838, says:—"Prof. Morse has recently improved on his mode of marking, by which he can dispense altogether with the telegraphic dictionary using *letters* instead of *numbers*." And finally, there is in existence a dispatch transmitted by Vail



Alfred Vail.

on January 24, 1838, which is recorded in the identical alphabetical code with which every operator of to-day is familiar. Whether this code originated with Morse or with Vail, is substantially the only disputed question of fact.

William Baxter, who was during this period an assistant of Vail, positively asserts that the alphabetical code was worked out

1. Abstract of a paper presented at a meeting of the Telegraphic Historical Society of North America, at Washington, May 1, 1895.

by him from a study of the type-fonts of the local printing-office. This, so far I know, is the only *direct* evidence that Vail was the inventor of the code, but there is circumstantial and secondary evidence which tends to confirm the testimony of Baxter. In response to an inquiry from Professor William B. Taylor of Washington, as to the evidence of Alfred Vail's invention of the dot-and-dash alphabet, Dr. W. P. Vail wrote:

"It was so understood by all who were admitted to his intimacy. In a conversation with him shortly before his death in 1859, he so assured me. I am not aware that Mr. Morse ever set up an adverse claim."

My view of the matter therefore,—if we assume it to be true that the alphabetical code of dots and lines, as distinguished from the nume rical code of dots only, was due solely to Vail,—is this:—

Morse applied to a certain structural organization already existing in the art, a particular mode of operation, viz., a numerical code of dots only, and this, together with the addition of a valuable but non-essential recording device, constituted his real invention. Vail subsequently applied to the same basic structural organization, another and an essentially distinct code, and in so doing made an original and independent invention, and this last, under the law of the survival of the fittest, has become the universal telegraph of to-day, while its predecessor has come to possess little more than a historical interest.

I do not discuss the contract relations which existed between Morse, Vail and others during the period in which the Morse patents were in force, which covered the whole remaining lifetime of Alfred Vail, for these, while they furnish an obvious explanation of Vail's reluctance to set up a public claim to his share in the inventions covered by the patents, ought not to be permitted to affect in any way the result of an inquiry into the true authorship of the commercial electric telegraph.

Having shown that the work of Morse, as well as that of Vail, was founded upon a typical structural organization contributed to the art by Henry, it remains to speak of one other contribution of the same philosopher, which constitutes the essential feature of the long-distance as distinguished from the local telegraph, and without which the main invention would be deprived of its principal commercial value; I refer to the long-coil, or as Henry called it, the "intensity magnet." Until Morse's attention had been called, by Dr. Gale, to the principles expounded in Henry's paper of January, 1831, his inability to operate his machine through even one-hundred feet of wire, had been a source of great discouragement. Having once possessed himself of a knowledge of the means of overcoming this obstacle, from the published researches of Henry, either directly, or as appears to have been the fact, through the suggestion of Gale, I think he had an undoubted right to incorporate it into his own invention. I have referred to this matter in part for the reason th at it affords me an opportunity to make a "personal explanation" of a matter which, through a perhaps natural misapprehension, has subjected me to some undeserved criticism.

While editor of THE ELECTRICAL ENGINEER, in 1889, I had occasion to notice a legal decision, then just rendered in a well-known patent case, involving a contested question of priority of invention of the fibrous carbon filament of the incandescent electric lamp, as between Thomas A. Edison and Sawyer & Man. The line of reasoning adopted by the eminent jurist (since deceased) who wrote the opinion in the case, seemed to me so remarkable —and I may parenthetically observe so fallacious—that I was moved to parody it in an editorial article which appeared in the above journal in November, 1889. But the result proved that as a humorous production my parody was scarcely a success. That the minds of the friends of Professor Morse may no longer be disturbed by the heretical opinions which have been erroneously attributed to me, I ask to be indulged in placing in parallel columns the judicial opinion and the offending editorial:—

Extract from Opinion of Mr. Justice Bradley, *in Consolidated Co. v. McKeesport Co.* Pittsburg, 1889.

"But suppose it to be true, as the supposed inventors, and some of the other witnesses testified, that they did in 1878 construct some lamps with burners of carbon made of fibrous material and of an arch shape, which continued to give light for days or weeks or months, still were they a successful invention? Would any one purchase or touch them now? Did they not lack the ingredient which was essential to their adoption and use? Did they go any further in principle, if they did in degree, than other lamps which had been constructed before?

It seems to us that they were following a wrong principle; the principle of small resistance in an incandescent conductor, and a strong current of electricity, and that *the great discovery in the art was that of adopting high resistance in the conductor with a small illuminating surface and a corresponding diminution in the strength of the current.* This was accomplished by Edison in his filamental thread-like conductor, rendered practicable by the perfection of the vacuum in the globe of the lamp. He abandoned the old method of making the globe in separate pieces, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum, the slender filaments of carbon, attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration for an indefinite time and with a small expenditure of electric force. *This was really the grand discovery in electric lighting, without which it could not have become a practical art*......Of course the form of the filament or globe in the receiver or globe may be varied at pleasure; it may be in the shape of a coil or a horseshoe, or it may be wound upon a bobbin. All these forms are old. The principle and great thing described is the *attenuated filament* and its enclosure in a perfect vacuum. There may be a preference of materials from which the filament is made. Practice will evolve all these collateral advantages. We think we are not mistaken in saying, that but for this discovery electric lighting would never have become a fact.

We have supposed it to be the discovery of Edison because he has a patent for it, this may not be the case; it may be the discovery of some other person. But whoever discovered it, it is undoubtedly *the great discovery* in the art of practical lighting by electricity. We have given a more detailed account of it in order to illustrate what we mean, when we raise the question whether the claimed inventions of Sawyer & Man were ever successful. They may have made a lamp that would burn; but was it a success or was it a failure? Did it ever go into use? What was the object of all the experiments made by them and others? Was it not to make an electric lamp that could successfully be used by the public and have a commercial value? Did they succeed in making such a lamp or in finding out the principle on which it could be made? We do not so read the evidence.

Extract from Editorial in *Electrical Engineer*, November, 1889.

"But suppose Morse did construct a telegraph consisting of a stylus moved by electro-magnetism which was exhibited in actual operation for days and weeks and months? Was it a successful invention? Would the Western Union Telegraph Company purchase or use such a machine now? Did it not lack an essential ingredient which was necessary to its commercial usefulness? Did he go any further in principle if he did in degree, than did Henry in 1831?

It would seem that he was following a wrong principle; the principle of small resistance in his electro-magnet and a strong current of electricity, and that the *great discovery in the art of telegraphy was that of employing high resistance in the electro-magnet, with a small wire and a corrresponding diminution in the strength of the current required.* This was accomplished by Gale with his filamentary thread like magnet-wire, rendered practicable by the placing of the battery elements in series. With such a battery, the slender, filamentary magnet-wire, attenuated to the last degree of fineness, may be made to do its work through a circuit of hundreds of miles with a small expenditure of electric force. This was really the *grand discovery in the art of electric telegraphy, without which it could not have become a practical art.*"

"Of course, the form into which the wire is coiled may be varied at pleasure; it may be wound upon a cylinder or a horseshoe or it may surround a galvanometer needle. All these forms are old. The principal and great thing is the *attenuated conductor* and its use in connection with a series of many cells. There may be a preference in the metal from which the attenuated conductor is made. Practice will evolve all these collateral advantages. We think we are not mistaken in saying that but for this discovery, electric telegraphy would never have become a fact.

We suppose it to be the discovery of Professor Gale. It may not have been so; it may have been the discovery of Professor Henry. But whoever discovered it, it is undoubtedly *the great discovery* in the art of communicating intelligence to a distance by electricity. We have given a more detailed account of it in order to illustrate what we mean when we raise the question whether the claimed invention of Morse was ever successful. He may have made a telegraph that would record arbitrary signs, capable of being interpreted; but was it a success or was it a failure? Did it ever go into use? What was the object of all the experiments made by him and others? Was it not to make an electric telegraph that could be successfully used by the public and have a commercial value? Did he succeed in making such a telegraph, or in finding out, until Gale told him, the principle upon which it could be made? We do not so read the evidence. In view of the most recent decisions, Gale and not Morse is the man to whom we are indebted for the art of transmitting telegraphic signals to a sufficient distance to be of any practical utility.

Without presuming to question the abstract justice of the decision of the Court in the incandescent lamp case, I think it must be admitted that the process of reasoning by which the

result was reached, needs only to be applied to the precisely analogous case of the electric telegraph to render its inconsistencies sufficiently apparent, and this, and this only, was the end sought to be accomplished in the article to which I have referred.

In conclusion I desire to say that I yield to no one in profound admiration for the genius, the patience, the industry and the unwearied perseverance of Professor Morse. The system of telegraphy which has grown by a continuous process of evolution from his crude machine of 1836, has proven itself to be the best in the world. Mr. Charles L. Buckingham has aptly said that the work of Morse may be compared to the centering of a massive and beautiful arch, by which its form, dimensions, and structural characteristics are determined, and without which its very existence would be impossible. What though this necessary preliminary structure forms no part of the complete edifice? Is any less honor due to its design and constructor? Does not the spirit and soul of his work remain, even though its material embodiment is cast aside, when its mission has been fulfilled?

TELEPHONY.

THE DUNDERDALE ROTATING TELEPHONE TRANSMITTER.

Mr. C. F. Dunderdale, of Chicago, an old expert and inventor in the electrical field, has recently brought out a type of telephone transmitter possessing several novel features. While recognizing the good qualities of a granular carbon in a transmitter, the tendency to packing has to be avoided, and this he has secured by means of a constant rotation of the case containing the granules, so that the carbon granules are in a constant state of reversal of position, thus preventing their settling and the ensuing separation of the grains, the finer from the coarser, the former collecting at the bottom, and the latter at the top, and which the shaking only aggravated and increased the tendency to solidify.

One of the means of accomplishing this result, is to provide a lever and ratchet movement, the lever being the support hook of the receiver, the act of hanging up and taking down of which causes the rotation to be secured automatically. The switching is done entirely in the receiver, as ordinarily. When raised to the ear the battery and line are cut in, and when returned to the perpendicular position it cuts out both. The signalling apparatus, being in shunt with the line, is always ready to respond to or give a signal call.

Mr. Dunderdale has also departed from the vibrating diaphragm theory, and by suppressing its vibration and depending on the molecular disturbance of its mass acting in the granules, claims to have secured a more perfect timbre or quality of sound transmission, by which every characteristic of the voice is preserved, whether the transmitter is shouted at or whispered into, all extra vibratory sounds or echoes being eliminated.

Mr. Dunderdale has also improved the receiver construction, by employing devices which compensate for the expansion and contraction of the magnets and extension pieces, and the rubber shell, so that the air space between the diaphragm and extension pieces is preserved through all ranges of atmospheric temperature changes and the perfect adjustment of the receiver preserved. In the use of the receiver as an automatic switch, an advantage is gained in that the receiver can be left hanging by its cords, or left standing on a desk. After using, the battery is cut out of action, until again taken up for use. The design also avoids the hook support patent.

The St. Charles, Mo., telephone exchange is fitted up with these instruments and users there it is asserted can stand off thirty feet from the transmitter and talk in an ordinary tone of voice and have their words clearly transmitted to the distant point.

The Dunderdale apparatus is now being exploited by the Automatic Long Distance Telephone Syndicate, of No. 184 Dearborn St., Chicago.

THE TELEPHONE IN MEXICO.

The Standard Telephone Company has decided not only to compete with the Bell Telephone Company in the United States, but has organized a company with a capital of $2,000,000 to enter the field in Mexico. Application for a concession has been filed.

"PLUNK."

The Monticello, Ill., Mutual Telephone Company has been licensed. It has no capital, but one of the directors is named Plunk.

ORTONVILLE, MINN.—F. F. Fargo, of St. Paul, has closed a contract with the business men here for putting in a telephone system. A line will also be run across and connect this city with Big Stone City, S. D., and its principal houses.

THE PHOENIX NATIONAL TELEPHONE.

The accompanying engravings represent the transmitter now being manufactured by the Phoenix National Telephone Co., the invention of Mr. E. E. Yaxley. As will be seen, it embodies a carbon electrode C carried loosely in a collar secured to a wooden diaphragm I, and a second carbon electrode D carried on a

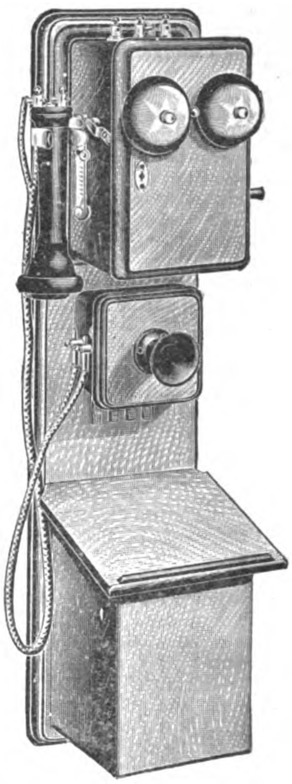


FIG. 1.—PHOENIX YAXLEY TELEPHONE.

swinging arm, which is held into contact with the electrode on the diaphragm by means of a weight F attached to a second arm extending out at an angle with the electrode-carrying arm; the point of attachment of the weight being adjustable on its arm to vary the force of contact between the two electrodes, and the weight of the electrode carried by the arm being opposed to that of

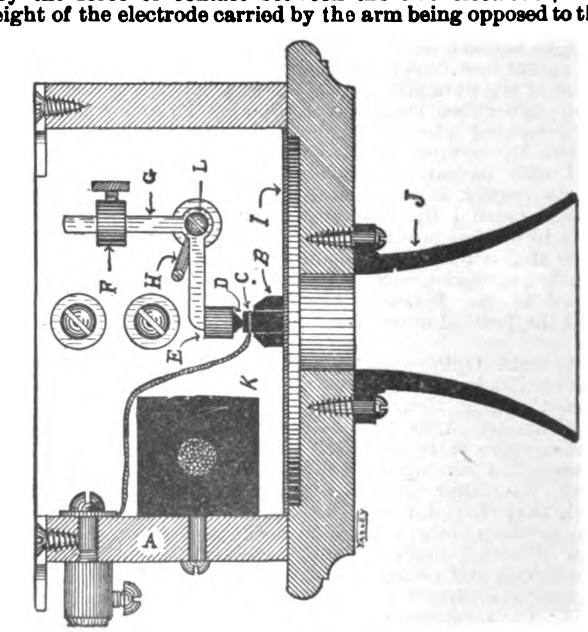


FIG. 2.—PHOENIX YAXLEY TELEPHONE.

the adjustable weight. A "double circuit" system of wiring is employed, whereby a signaling circuit is established independent of the talking circuit and of the local circuit. A simple switch lever is adapted to open and close this local circuit without in any manner affecting the signaling circuit, the lever also being provided with a hook upon which the telephone receiver is hung, thus rendering it convenient to operate the switch lever by hand

at the same time the receiver is placed thereon or removed therefrom.

The Phoenix company have had their patent claims thoroughly examined by Mr. Chester Bradford, of Indianapolis, who in a written opinion declares their system free from infringement of other existing patents.

TELEPHONE NOTES.

MYERSTOWN, PA.—Daniel Drawbaugh will build a telephone factory at Myerstown, to employ 50 hands.

BRYAN, TEX.—It has been found necessary to enlarge the Bryan telephone exchange to a 150-drop switchboard.

PORT JERVIS, N. Y.—A new telephone company, a branch of the Phoenix, is being organized in Port Jervis.

PORTLAND, ME.—The Standard Telephone Company has been granted the right to string wires in Portland, and proposes to give service at one-half of the Bell rates.

HILLSBORO, TEX.—The council has passed an ordinance granting a franchise to the Southwestern Telephone Company to put in a telephone system.

HARVARD, ILL.—The Harvard Telephone Company has been formed; capital stock, $2,500; incorporators, John C. Blake, John F. Reham, Herbert D. Crumb.

MARQUETTE, MICH.—The Upper Peninsula Telephone company has been organized to operate in this city under the franchise recently granted to B. S. Kaufman.

CUMBERLAND, WIS.—The city council has granted a franchise to T. W. Borum and De Witt Post, of Barran, to erect, establish and operate a telephone system.

SCRANTON, PA.—An ordinance has been introduced granting permission to the Interstate Telephone Company to maintain an electric plant in the city and erect poles and wires.

ANGOLA, IND.—A telephone company has been formed in Angola, purposing to connect various towns in Northern Indiana by telephone. The line will extend as far south as Waterloo.

TAMPA, FLA.—The stockholders of the Citizens' Telephone exchange have met and organized, the officers being S. J. Drawdy, president; A. C. Clewis, vice-president; C. H. Keller, secretary and general manager; John Trice, treasurer.

LINCOLN, NEB.—Promoters of the proposed new telephone system have succeeded in interesting six or eight Lincoln citizens, and articles of incorporation are now being drawn up. The capital stock is to be $50,000.

VINEYARD HAVEN, MASS.—Dr. C. F. Lane has his new telephone system in operation between Vineyard Haven and Cottage City. He is now pushing his line toward West Chop and thence to Makonikey, and the up-island villages, and later to Edgartown.

NORTH ADAMS, MASS.—The North Adams selectmen have granted permission for Manager Steadman of the telephone company to put all wires under ground. The work will cost about $20,000. The town gets a free conduit for its fire alarm wires.

BELAIR, MD.—The Delta Telephone Company has been organized with the following officers: President, L. K. Stubbs; vice-president, C. R. McConkey; secretary, T. D. Stewart; treasurer, J. Howard Stubbs; manager, C. O. McConkey.

NEWARK, DEL.—The Electric Supply and Construction Co., of Wilmington, is putting in a fire alarm system at Newark. The equipment includes a number of telephones, which are being placed in different parts of the town and which will be connected with the water department office and the hose house.

NEW ORLEANS, LA.—An ordinance grants to Messrs. A. T. Moss, G. R. Penrose, W. P. Richardson, J. W. Stone, and their associates, etc., the right to construct, etc., for a period of twenty-five years, a telephone exchange, and in connection therewith the necessary lines of telephone wire through the streets, etc.

PARIS, KY.—The City Council has given the Paris Telephone Company a ten-year franchise in this city, and the company, which has organized, will begin at once to erect its poles and make connections with the outside world. H. A. Power is President, and Dr. H. H. Roberts Secretary and Treasurer.

MARSHALLTOWN, IA.—The Marshall Telephone Company at Marshalltown has filed articles of incorporation. The capital stock is to be $50,000. The directors for the first year are C. F. Bennett, H. J. Howe, T. J. Fletcher, S. C. McFarland and A. A. Moore, who are also incorporators.

SALT LAKE CITY, UTAH.—The Bear Lake Telephone Company, composed of Messrs. John R. Brennan, Jeff Davis, M. D. Wells and W. N. B. Shepherd, will begin immediately to build a telephone line and they hope to have it in operation within thirty days.

CARTHAGE, MO.—The franchise granted to the American Electric Telephone Co., of Kokomo. Ind., has been transferred to Messrs. T. J. Clark and George Wheeler of this city.

PATCHOGUE, N. Y.—The Telegraph Company has been granted a franchise by the village trustees to erect poles and wire for their long distance telephone service, soon to be established. The franchise is not exclusive.

GREENSBURG, PA.—The Westmoreland Telephone exchange will commence work on the construction of lines to Irwin, Jeannette, Latrobe, Scottdale, Mt. Pleasant and West Newton as soon as possible after the Greensburg system is completed.

GALION, O.—The city committee has reported favorably upon the granting of a 20 year franchise giving to Walter Marlatt, the right to construct and maintain a telephone exchange in this city with certain restrictions.

DAYTON, O.—The Dayton Telephone Company, of which Mr. J. C. Patterson is president, is already in the field with 700 subscribers, proposing to cut rates in two, and only waiting for a franchise from the council to begin operations.

HAWLEY, PA.—The town council has granted the franchise to the Citizens' Telephone Company, conditionally on the company commencing building operations within two months and being in working order in six months from the date of the franchise.

CHATTANOOGA, TENN.—An application for a charter for the Citizens' Telephone Company of Chattanooga, was filed by I. F. Stone, W. D. Carswell, T. R. Preston, H. C. Abercrombie and William K. Stone.

CAMDEN, N. J.—Articles of incorporation have been filed by the United States Telephone Construction Company. The capital stock is placed at $50,000, while the company will commence business on $1,000.

EAU CLAIRE, WIS.—Huddleston & Woodin of Chicago, the grantees of the telephone ordinance recently passed by the Eau Claire council, have accepted it and have prepared plans and estimates for exchanges at Eau Claire, Chippewa Falls and Menomonie. They have a franchise at Chippewa Falls.

PRINCETON, ILL.—A home telephone company has been organized at Princeton with over 100 subscribers. Nearly all the subscribers of the company are patrons of the Central Telephone Company and it is the intention to reduce rates from $48 per year to $15.

NEW YORK, N. Y.—The New York and New Jersey Telephone company proposes to extend its system to the east end of Long Island this year, taking in Greenport, Shelter Island, Riverhead, Sag Harbor, Southampton and other points. The central office will be located at Riverhead.

ANTIGO, WIS.—At the last council meeting, T. D. Kellogg, A. M. Loning, L. E. Bucknam and J. J. Kingsbury of this city asked for a thirty-year franchise to establish and operate a telephone system at rates not to exceed those of other cities of this state. The request meets with no opposition.

SALISBURY, MD.—A charter has been granted the Wicomico Telephone Company for the erection of a telephone line from Salisbury through the western portion of the county, tapping Kuantico, White Haven, Nanticoke, Tyaskin, Bivalve and other villages.

NORTHFIELD, MINN.—Tennant Brothers have organized a local telephone exchange. They have already received about 65 subscribers. The lines will be in operation in six weeks. The organization of this company has had the effect of bringing down the rents of the Northwestern Telephone Exchange instruments 25 per cent.

NEWARK, N. J.—The New York and Philadelphia Telegraph and Telephone Company has filed articles of incorporation with the county clerk. The company has a capital stock of $15,000 divided into 150 shares. Its incorporators are E. P. Meaney, of Newark; M. Egleston, of Elizabeth and A. E. Holcombe, of New York. The object is to erect telegraph and telephone wires from New York to Philadelphia.

NYACK, N. Y.—The Rockland Telephone and Telegraph Co. has been organized for the purpose of constructing a telephone line throughout the county. The officers of the company are: Wm. R. Thompson, president; A. A. Demarest, vice-president; Lewis H. Hutton, secretary; George A. Blauvelt, treasurer, and Wm. Dewey, Chairman of the Executive Committee. The main office and exchange will be in Nyack.

PORTLAND, ME.—The Casco Bay Telegraph and Telephone company has leave to erect some 400 or 500 poles in various parts of the city and to maintain wires on them. The directors of the company are G. S. Hunt, W. F. Milliken, J. W. Deering, E. B. Winslow, Geo. P. Wescott, Seth L. Larrabee and G. W. Brown. The capital is $100,000. It was stated that the new company had secured some 1,200 or 1,500 subscribers. The cost of telephones will be one half the rates now charged.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 7, 1895.

Accumulators:—

Absorptive Material for Storage Batteries, E. R. Knowles, Brooklyn, N. Y., 538,919. Filed Oct. 15, 1891.

The process of forming an absorptive material for storage batteries, consisting in first making a mixture of seventy-five per cent. of red oxide of lead, and twenty-five per cent. of yellow oxide of lead, and then treating this mixture with sulphuric acid and water until complete sulphation has taken place.

Conductors, Conduits and Insulators:—

Interior Conduit, O. G. Traphagen & F. W. Fitzpatrick, Duluth, Minn., 538,983. Filed Feb. 4, 1895.

A flat strip made of insulating material and having channels therein, a molding secured to said flat strip at each side thereof, and a face or plate held in place between said moldings and supporting the wires.

Distribution:

Electric Lighting System, R. N. Chamberlain, New York, 538,019. Filed Oct. 22, 1894.

A combination of an alternating motor driving a continuous current machine for charging storage batteries.

Dynamos and Motors:—

Alternating Current Motor, E. Arnold, Zurich, Switzerland, 538,648. Filed July 10, 1894.

Claim 1.—The method of starting and operating motors for alternating and similar currents, by supplying current to the field coils in a manner to produce poles at certain fixed points, and current of different phase in a manner to produce poles at an angle with the first said poles, thereby producing a rotary field, and thereafter diminishing the said angle by commutating or changing the field connections and diminishing the difference of phase.

Safety Device for Electric Motors, R. Eickemeyer, Yonkers, N. Y., 538,669. Filed July 18, 1892.

Claim 1.—The combination with a shunt motor, of a safety device including both branches of the circuit of the motor and arranged to short circuit the motor on disturbance in the balance of said circuits.

Electric Elevator, G. H. Reynolds, New York, 538,700. Filed Jan. 27, 1890.

Details covering the operation and governing.

Speed Regulator for Electric Motors, F. B. Rae, Detroit, Mich., 538,744. Filed Aug. 28, 1894.

Consists in the construction of a rheostatic arm driven forward by frictional devices actuated by the motor, and stops on an arm of the wheel for checking and returning the same.

Dynamo Electric Machine, A. G. Waterhouse, Pittsburg, Pa., 538,757. Filed Feb. 4, 1889.

The invention consists in constructing the field magnet with divided pole pieces, six, eight, or more in number, the strengths of which are to a greater or less extent independently controllable.

Commutator, J. P. B. Fiske, Alliance, Ohio, 538,825. Filed Feb. 9, 1895.

An improvement in the cross connections of the commutator segments.

Lamps and Appurtenances:—

Electric Arc Lamp, S. S. Allin, London, Eng., 538,999. Filed Oct. 29, 1894.

Details of construction.

Miscellaneous:—

Electric Soldering Iron, W. H. Osborne, Prince's Bay, N. Y., & G. R. Meltzler, Cincinnati, Ohio, 538,695. Filed Feb. 13, 1895.

The heating wire is embedded in calcined powdered soap stone with a small percentage of lamp black; the tool also has an attachment for supplying solder operated electrically by a push button in the handle.

Electrotherapeutic Apparatus, F. Borsodi, Magyar-Banhegyes, Austria, Hungary, 538,764. Filed Oct. 22, 1888.

A battery to be worn next the body.

Electric Tower Clock, J. H. Gerry & F. M Schmidt, Brooklyn, N. Y., 538,773. Filed Nov. 15, 1894.

Cautery Electrode, M. F. Laughlin, New York, 538,971. Filed Mch. 7, 1894.

Process of Manufacturing Chromate of Lead, A. B. Browne, Cambridge, Mass., and E. D. Chaplin, Natick, Mass., 538,998. Filed Apl. 18, 1894.

Consists in first producing a solution of a soluble salt of lead, as the nitrate, acetate or chloride, simultaneously preparing a solution of chrome alum, precipitating chrome hydrate therefrom, mixing said chrome hydrate with an excess of caustic alkali to redissolve it, mixing the resulting strongly alkaline solution with a solution of common salt, passing an electric current through said combined solutions to decompose the alkaline solution and produce a mixture of bichromate and chromate of potash, mixing said combined bichromate of potash with said salt of lead chromate and washing it with water, refiltering it to remove the water, and finally drying the resultant product.

Electrical Hose Signaling Apparatus, W. Fowler, Colorado Springs, Colo., 539,000 Filed June 20, 1894.

Electrically Arranged Hose Coupling, W. Fowler, Colorado Springs, Col., 539,017. Filed Nov. 30, 1894.

Railways and Appliances:—

Closed Conduit Electric Railway, G. E. Baird, Chicago, Ill., 538,649. Filed Apl. 30, 1894.

Details of construction.

Closed Conduit Electric Railway, G. E. Baird, Chicago, Ill., 538,650. Filed June 11, 1894.

Details of construction.

Preventing Electrolysis of Street Pipes, R. Watkins, Sacramento, Cal., 538,758. Filed June 25, 1894.

The combination, with the street pipe, having a connection with a source of electrical supply, and the rails, of conductors connected to the rails, plugs screwed into the pipe and connections between the plugs and conductors.

Electric Railway, H. R. Mac Lean and G. A. Kornetzke, Schenectady, N. Y., 538,786. Filed Aug. 3, 1894.

A conduit formed in or adjacent to a rail upon which the vehicles travel and containing an electric conductor, in combination with a vehicle wheel provided with a concentric insulated spring-mounted metallic disk projecting into the conduit and making electric connection with the conductor therein.

Supply System for Electric Railways, W. Lawrence, New York, 538,838. Filed April 28, 1894.

Relates to a junction box for an underground conduit system of electric railway.

Trolley Bar, C. Parker & A. R. Trepagnier, New Orleans, La., 538,844. Filed July 13, 1894.

Claim 1.—A trolley comprising the lower wheel at the end of the main bar, the supplemental bar pivoted on the main bar and the upper wheel carried at the forward end of the supplemental bar, and bearing on the top of the wire or conductor.

Electrical Connection, J. M. Faulkner, Philadelphia, Pa., 538,904. Filed Feb. 28, 1895.

A rail bond in which the end of the bond dips into a mercury trough formed in the rail.

Switches and Cut-Outs:

Electric Transfer Switch, A. Ekstrom, Lynn, Mass., 538,670. Filed Sept. 7, 1893.

Provides a thick plate or base of refractile, non-pliable, insulating material, such as slate, on one side of which are arranged the terminals or contacts of the switch, with the handle on the other side.

Telegraphs:—

Telegraph Key, C W. Bradford, Clinton, Me., 538,651. Filed Jan. 24, 1894.

Contains a secondary lever connected with the main key lever so arranged as to close the circuit automatically when the operator takes his hand from the key.

Telegraphic Sounder, J. H. Bunnell, New York, 538 816. Filed Apl 19, 1893.

Claim 1.—A telegraphic sounder comprising a resonator mounted upon a base at a plurality of points, an anvil rigidly connected to the resonator between said points, and an electro magnet and armature mounted upon the resonator closely adjacent to its points of support, whereby said resonator is free to vibrate independently of the inertia of the electro-magnet.

Telephones:—

Telephone System, J. W. McDonough, Chicago, Ill., 538,975. Filed May 21, 1891.

An automatic exchange system.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The annual meeting will be held at 12 W. 31 St., New York, on May 21, at 8 p. m., instead of May 14. The full meeting will not take place till the end of June at Niagara Falls. At the May 21 meeting, the election of officers, etc., will be taken up, and discussion resumed on Prof. Anthony's paper on wiring; while if time permits, a paper will also be presented.

FINANCIAL.

NEW YORK CITY EDISON BOND ISSUE.

The directors of the Edison Electric Illuminating Co., of New-York have decided to authorize the issue of $15,000,000 100-year 5 per cent. gold consolidated mortgage bonds for the purpose of extending the business of the company in the upper part of the city. Of the amount authorized enough will be held in reserve to provide for the $5,000,000 first mortgage 5 per cent. bonds maturing in 1910, of which $4,312,000 are outstanding. A portion of the issue will also be used to replace equal amounts of bonds and other obligations of the Manhattan and Harlem companies held by the Edison Company. The bonds of the controlled companies held will then go in as additional security under the new mortgage, and it may be decided to purchase the outstanding bonds of these companies, in order firmly and permanently to unite all the electric lighting and power interests of the city of New York. The new $15,000,000 consolidated mortgage will contain a provision that the total issue of bonds of the company, including the 5s now outstanding, shall not at any time exceed the outstanding issue of capital stock. The proposition has been submitted to the stockholders for their approval, which has duly been given.

MARKED UPWARD TENDENCY OF STOCKS.

The course of the stock market last week was a surprise even to those who had been optimistic about the change in financial and industrial conditions. Owing to the large purchases made in England and Germany, the prices of American stocks and bonds were most favorably affected, throughout the list, although railways benefitted most. So marked a gain has not been seen for years, and it is thought that during the coming week, all the gains will be more than held. The government crop report is excellent.

During the week 32,075 shares of Western Union were sold, moving up to 93⅝. Commercial Cable showed an advance on 338 shares up to 148½. General Electric sold 31,293 shares in the six days, reaching 34¼. In Boston American Bell went up to 198. Nearly all local lighting and electric railway enterprises exhibited a material improvement in quotations.

OBITUARY.

A. Q. KEASBEY.

The death is announced at Rome, Italy, of Mr. A. Q. Keasbey, of Newark, N. J., at the age of 71. He was a well known lawyer actively connected with various enterprises, including the Newark street car system.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE MOYES COMBINE SAFETY WATER TUBE BOILER.

THE COMBINE SAFETY WATER TUBE BOILER illustrated in the accompanying engravings, is patented and manufactured by Mr. L. M. Moyes, 411, 413 Walnut St., Philadelphia. The boiler is "sectional" and of the water tube type, in which the steam and water drums are arranged transversely to the flow of gases from the furnace to the outtake to chimney. Mr. Moyes makes a broad claim to continuous and positive circulation throughout the entire boiler system. Fig. 1 shows a perspective elevation, of a battery of 616 H. P.; Fig. 2, a side elevation, showing an assembled boiler.

In elevation the boilers present a neat and compact appearance; the steam and water drums are encased in blocks of without packing, thereby removing all pressure from the outside joint. Each manifold is connected to the distributing drum by a 5″ nipple; for ordinary high pressure the distributing drums are also steel, annealed. The sections are connected to and with each other by circulating tubes set at the same angle as the tubes, and are 5″ in diameter; each distributing drum has a separate blow-off valve.

In the operation of the boiler the gases as will readily be seen, have a very long contact with the heating surfaces in their flow from furnace to outtake. As indicated by the arrows, the circulation of water and flow of steam generated in the tube is upwards in the two forward sections into the two front drums, with ample disengaging space; thence, by the connecting devices to the rear drum (into which the feed is also being delivered) downwards in the rear section to supply.

The many ingenious and mechanically designed connections between sections provide for every possible strain due to expansions. The steam drums rest (not suspended) on I-beams in such manner as to remove all carrying strains from the tubes. The transverse section through the front steam drum shows the separator dry pipe in each drum. The section through the rear drum shows the feed water sump; the feed pipe is connected to the sump and into it the feed water is delivered. The sump is of cast iron, on

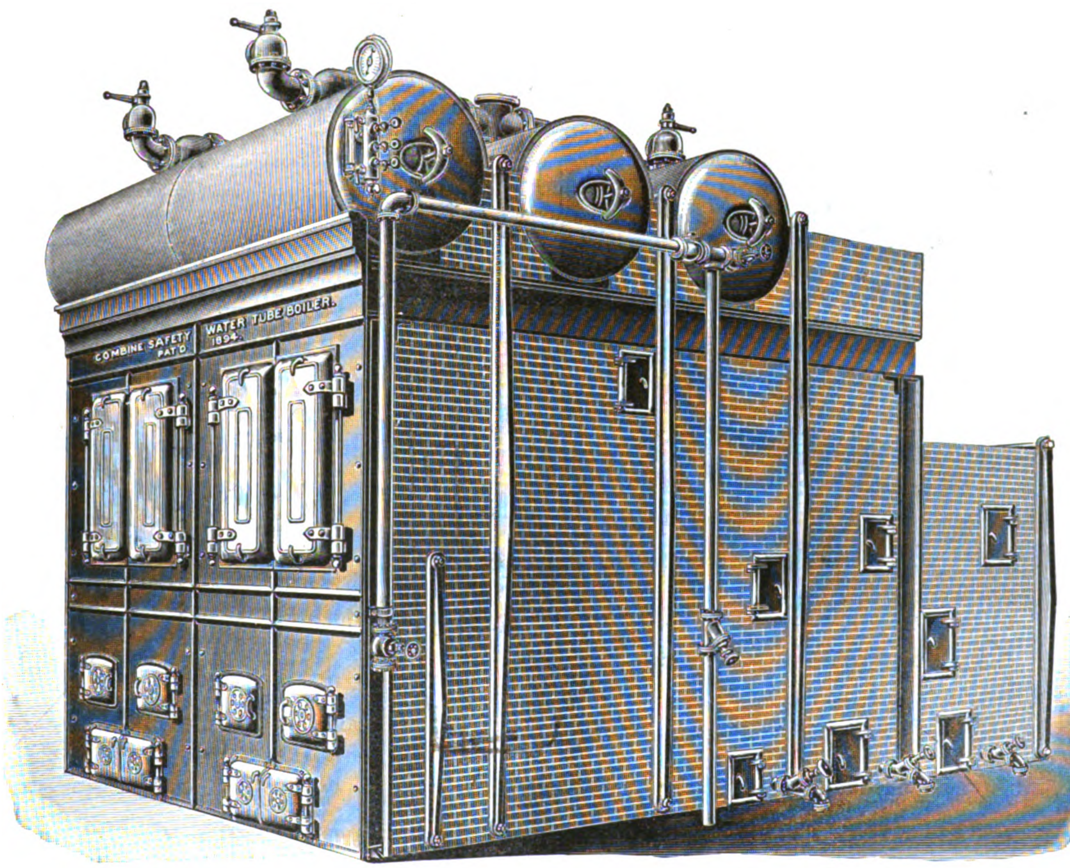


FIG. 1.—THE MOYES COMBINE WATER TUBE BOILER, ELEVATION.

"Makite" moulded to the radius of the drums, the bench being formed by a break in the lines of brickwork. The space in the rear of the steam and water drums, as shown in elevation, is utilized for the carrying of the main flue, with a number of batteries, or the stock, with one battery, or one boiler, reducing very considerably the floor space required. The fronts of the boilers are of cast iron, of handsome design and are supported entirely free of the brickwork around the boiler. The frame upon which the steam drums rest is formed of I-beams braced and tied so as to be self supporting, and is also independent and separate from the brickwork.

The side elevation presents a fairly good idea of the arrangement of the boiler. The tubes (standard 4″ x 18′) on an angle of about 45 degrees are expanded at the upper end into the tube sheet in the steam drum, and at the lower end into the tube seats in the "manifolds." The manifolds for power plants are open hearth cast steel thoroughly annealed, making this section of the boilers stronger and more enduring than forging; each manifold has an area almost equal to an eight inch tube. Opposite each tube is a hand-hole closed with an inside and outside plate also of steel, the seat on the outside face of the manifold and the face of the outside plate being machined so as to form a perfect joint without packing. The inside plate forms an almost perfect joint which is placed loosely a light cast iron cover, which continues to within a short distance of the end of the sump, forcing the feed to travel its entire length, and in so doing acquiring the temperature of the water in circulation in the boiler before coming in contact with the same, thereby depositing many of the impurities in solution, and suspension, which is removed by the use of the blow-off valve attached for that purpose. Should the deposit in the sump accumulate through inattention to such an extent as might interfere with the passage of the feed, the cover, being placed on loosely, would be forced off by the accumulating pressure, due to the feed delivery, and thus enable the feed to enter into circulation. The circulating and compensating tubes by which the steam drums are connected, are shown in the side elevation, Fig. 2; also the cross steam pipes on top of the drums, to which are attached the safety valves. These cross pipes are of "steel" with flanges cast on.

Forethought is displayed in the facilities for the removal and replacement of damaged tubes. A tube from any section in the boiler can be easily removed without interfering with adjoining tubes. The removal of a deposit from the inner surface of the tubes is effected either by introducing the scraper, at the lower end through the hand hole, or at the upper end from the steam drum. The smallest steam drum used on this boiler is forty-two inches in

diameter, giving ample space for men to operate when cleaning tubes. The chamber at the lower end is also sufficiently roomy for the cleaning. The facilities for cleaning tubes has been based on the practice of many years' experience with this type of boiler; a specially designed scraper and handle is used. The hand holes in the distributing drums are covered and protected in the same manner as those of the manifold, the same fittings being used in both cases.

An important feature in the "Combine," is due to the ability to ship the boiler as an almost completed unit. Each boiler is shipped in three sections, the section consisting of steam drum, tubes, manifolds and distributing drum. These are assembled and tested at the works, only requiring the connecting of the same at the point of erection to form the completed boiler. What will be at once apparent with a survey of the "Combine" is the determined simplicity of form the boiler assumes when finished. All sections are connected by expanded tubes or nipples, not a single bolt, or threaded connection, being employed. The tubes forming the heating surface are practically straight. The slight bend in the two tubes in each section made necessary for alignment in entering the tube holes in the drums, is perfected at the tube mills during the process of manufacture. These tubes are in every respect interchangeable into the different sections.

It will be observed that there are no departures from the established lines of the standard boilers of the water tube type. The assemblage of heating surfaces, the building up with standard tubes, drums and manifolds, and their relation to each other, the travel of gases in contact with heating surfaces, the circulation of water and flow of steam due to the devices patented by Mr. Moyes are identical with their dispositions, in the better known boiler with which he was for so many years connected. This takes the "Combine" at once from out the ranks of the experimental class. Mr. Moyes will make a specialty of boilers for power plants, but the "Combine" is also adapted for office and other large buildings where sufficient head room for the ordinary boiler is at times a difficult problem to solve. Another very satisfactory feature in the "Combine" is the fact that in price it is in direct competition with the return fire tube boiler. It is built in units ranging from 50 H. P., to 600 H. P., and is capable of carrying a working pressure up to 200 pounds per square inch. A test of a plant of these boilers will be made shortly.

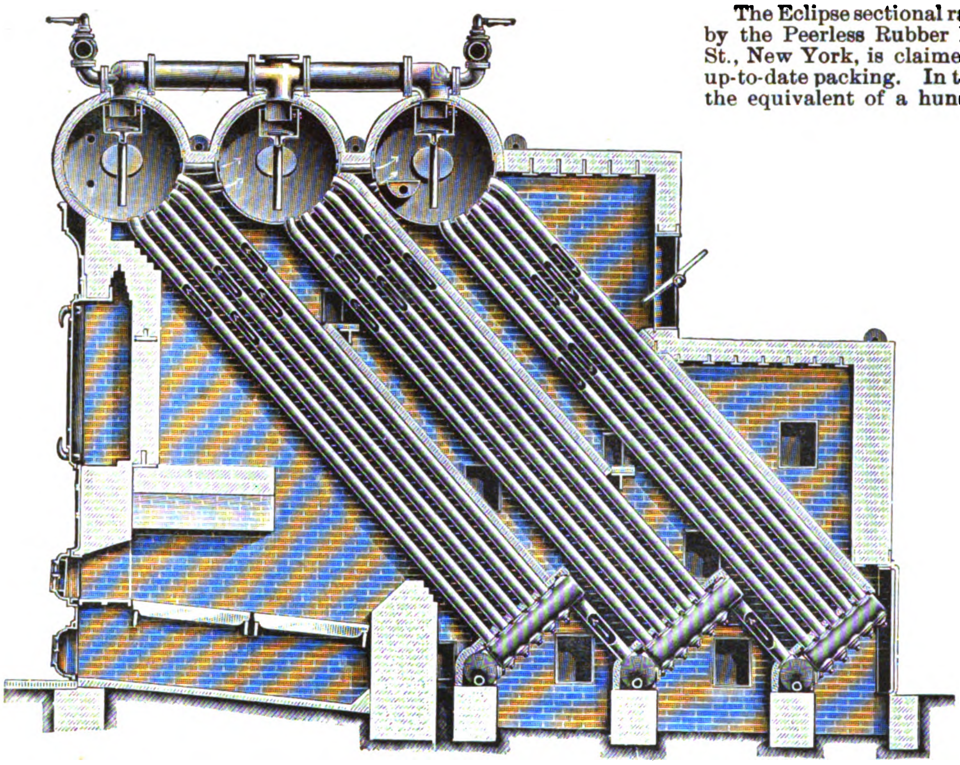


FIG. 2.—THE MOYES "COMBINE" WATER TUBE BOILER.—SIDE ELEVATION.

SOUTHERN NOTES.

RICHMOND, VA.—The Old Dominion Electrical Company has enlarged its business and re-organized as follows: C. Y. Bargamin, president; Edward H. Garcin, vice president, Maurice Hunter, secretary; Frank Mosby, treasurer, and Maurice Thomas, general manager. Directors: C. Y. Bargamin, E. H. Garcin, John Murphy, Wirt E. Taylor and John R. Williams.

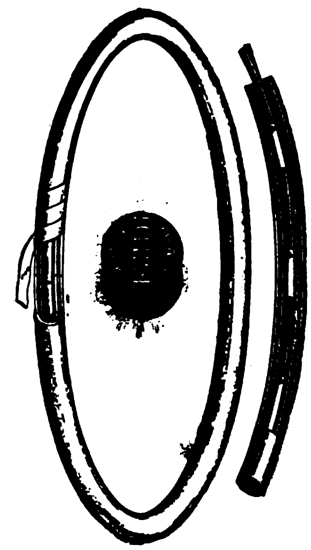
THE GOULDS MFG. CO.

The Goulds Mfg. Co., of Seneca Falls, N. Y., report the following sales:—The Solvay Process Co., Syracuse, N. Y., 1 12 inch x 12 inch triplex power pump, with steel ball valves, which is to be used for pumping waste. New Orleans Railway & Mill Supply Co., New Orleans, La., 2 5 inch x 8 inch triplex power pumps. Both of these pumps are to be operated by electric motor, one pump being geared to each end of the armature shaft, the pumps and motor being mounted on one bed plate. Freydenburgh Falls Pulp Co., Plattsburgh, N. Y., 1 10 inch x 12 inch triplex power pump. Michigan Alkali Co, Wyandotte, Mich., 3 6½ inch x 8 inch triplex power pumps. Manion & Co., New Orleans, La., 2 5 inch x 6 inch triplex power pumps. Robinson & Cary, St. Paul, Minn., 1 4 inch x 4 inch triplex power pump. They are very busy on triplex pumps at the present time, in fact, shipped last week the largest tonnage that has ever gone out from the works of the Goulds Mfg. Co., in six days.

The new machine shop for the Goulds Manufacturing Co., at Seneca Falls, N. Y., will be designed and built by the Berlin Iron Bridge Co. The building, as designed, will be constructed with a steel frame and a fifteen-ton traveling crane.

THE ECLIPSE SECTIONAL RAINBOW GASKET.

The Eclipse sectional rainbow gasket, manufactured exclusively by the Peerless Rubber Manufacturing Company, of 16 Warren St., New York, is claimed to embody all the requirements of an up-to-date packing. In two boxes of this gasketting are contained the equivalent of a hundred different sizes, so that a packing of any required size can be made instantly available. Another advantage of this mode of putting up the material is that there is no waste. It is made in ⅜ inch sizes for pipe unions; ½ inch for hand holes, and ⅝ inch for manholes. It is packed in boxes weighing respectively 3 and 4 lbs.



ECLIPSE SECTIONAL GASKET.

"DRAKE & WRIGHT" MAST ARMS.

The Hope Electric Appliance Co., of Providence, R. I., have issued the third edition of their catalogue of electrical devices, for 1895, and devoting special attention to mast arms, cut-out boxes, insulator brackets, pole steps, cable clips, hoods, etc. Their latest mast arm—the Drake & Wright—embodies many valuable features, such as were recently pointed out and illustrated in these pages. Great strides have been made in it, in the clever adaptation of means to ends, and the use of ingenious square section tubing of steel for the arm. The Drake & Wright arm, now rapidly becoming popular under that title has a large field of usefulness before it, as our article indicated. The same remark must be made of the Hope Co.'s other appliances, all of which are designed to meet a specific need in the lighting or railway field, and accomplish their purpose.

THE WESTINGHOUSE COMPANY has just contracted with the Plant system of railway to transmit about five hundred horse power for a distance of two miles to operate elevators to load phosphate rock, at Tampa, Fla.

THE STANDARD ELECTRIC CO. OF CHICAGO.

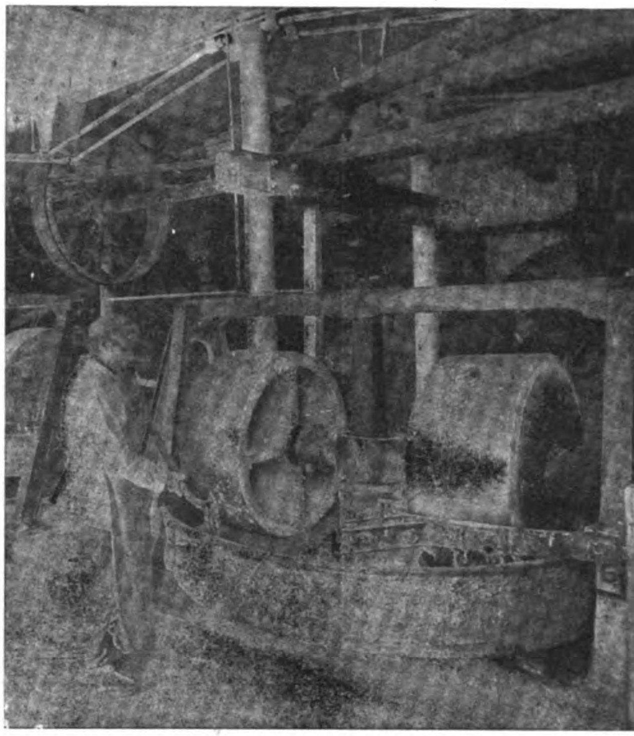
The financial editor of the *Chicago Sunday Tribune*, on May 5th stated that the Standard Electric Company of Chicago had increased its capital stock from $1,000,000 to $1,500,000 in order to provide increased facilities that will enable it to promptly and properly care for recent orders, and be the better prepared to handle future business. It also took the important step of electing to the presidency, Mr. A. G. Spaulding, the well known lover of field sports, and the head of thé firm of A. G. Spaulding & Brothers, dealers in athletic goods. Mr. Spaulding has purchased a large block of stock and will take hold with his accustomed enterprise, relieving Mr. S. P. Parmly who will remain in the Directory, but concluded to resign from the presidency, owing to the health of members of his family necessitating prolonged absence on his part. Mr. E. E. Crepin will continue to be treasurer and Mr. D. P. Perry the general manager. The remaining members of the Directory are Mr. Gilbert B. Shaw, president of the American Trust & Savings Bank of Chicago, Mr. J. P. Whitney, a capitalist of Philadelphia, and Mr. G. A. Rollins, a capitalist of Boston. In this connection it will be recalled that the Standard Electric Company was largely instrumental in enabling the World's Columbian Exposition to get a low rate for the electric lighting, establishing a price rate that enabled the Exposition officials to secure the 4,000 arc lamps for nearly one-half the sum originally called for. Moreover, the service plant that the Standard Company installed in Machinery Hall not only supplied 25,500,000 arc lamp hours, but accomplished all this, it is said, without the loss of an armature or even an armature coil. As the Company has under consideration the leasing of one of the largest factories in the West, manufacturers of machinery tools will be interested in this note.

THE DEAF HEAR.

The Electric Appliance Co., Chicago, tell of an amusing experience had by one of their salesmen in an Indiana town a few days ago. The salesman was exhibiting a pair of Improved Hunning telephones, manufactured by the Electric Appliance Company, which had been installed for exhibition purposes. A large committee of citizens were present to witness the test and were very much pleased and surprised at the wonderful power which the instrument developed; talking up so very much louder than anything they had been accustomed to. One of the committee present happened to be a man, who, for a number of years, has been almost deaf, so much so that conversation could be carried on with him only by means of considerable shouting. More for the purpose of a joke than anything else, the salesman asked this gentleman to try the telephone, which he proceeded to do, to the amusement of all present. It is hard to tell whether the man himself, or those watching the proceedings were the more surprised when the man who had been called deaf, was able to carry on a conversation with the other end of the line without any apparent difficulty. The old gentleman, himself, was so highly pleased, that he entertained the triumphant salesman royally that night and the next day, and said good-bye with tears in his eyes.

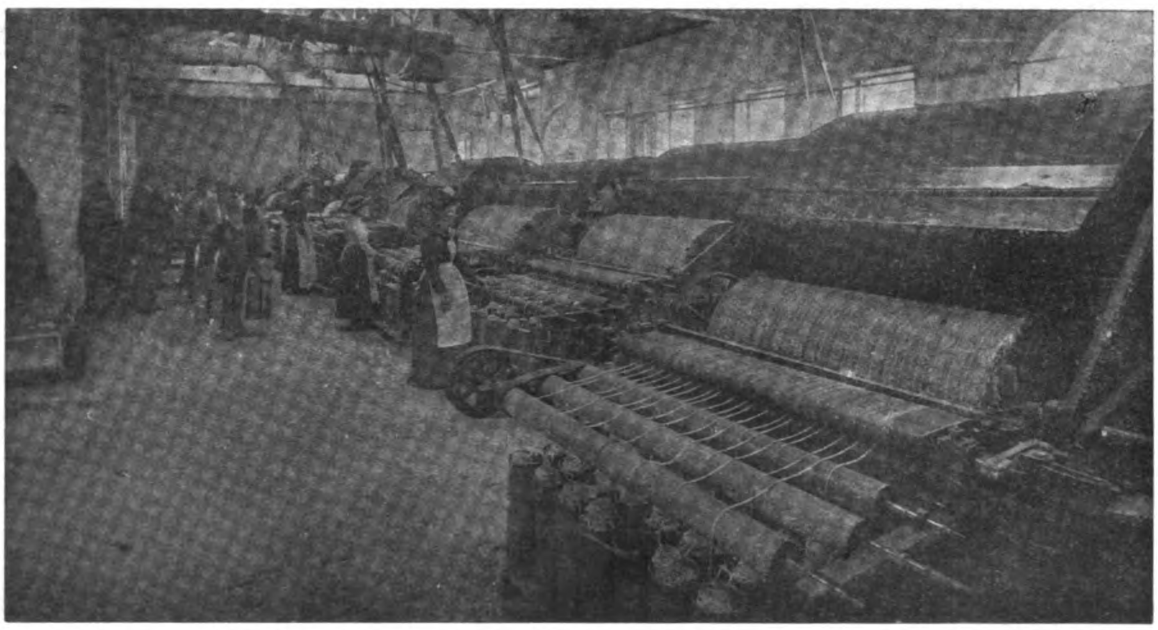
THE PRODUCTS OF THE NEW JERSEY ASBESTOS COMPANY.

Within the last few years asbestos has come to be one of the most important products in the electrical business. The pioneer



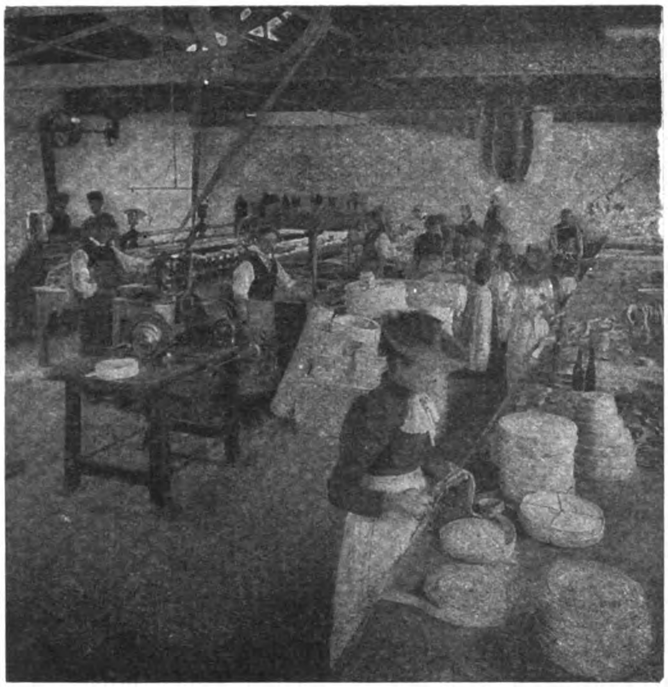
PREPARING AND CRUSHING ASBESTOS.

work of the industry in Europe was done mainly by the United Asbestos Company, who claim to be the first to make asbestos commercially available over its present wide range of applications, by evolving the art of spinning the product into a fine, indestructible thread or yarn which can be woven into cloth and other fabrics. This company are, it is said, the largest owners of asbestos fields in the world, and their mining properties in Italy alone, which produce an asbestos of a long and silky fibre, cover an area of eighty square miles. From this important company, the manufacturing and trading rights for the United States, together with patents owned or controlled, have been acquired by the New Jersey Asbestos Company, which has also secured the right to draw its supplies of asbestos from the United Asbestos Company's mines both in Italy and Canada. Although asbestos is found in



CARDING AND CONDENSING ASBESTOS AT THE FACTORY OF THE NEW JERSEY ASBESTOS CO.

all quarters of the globe, the only kinds hitherto found suitable for commercial purposes are, it is stated, the "Italian" and "Canadian" varieties. These possess the properties of infusibility, tensile strength, fineness and elasticity, which are so essential to manufacturers and the users of asbestos. A common fault with many kinds is, that they are so brittle as to be worthless for spinning or weaving purposes.



MAKING ASBESTOS GASKETS.

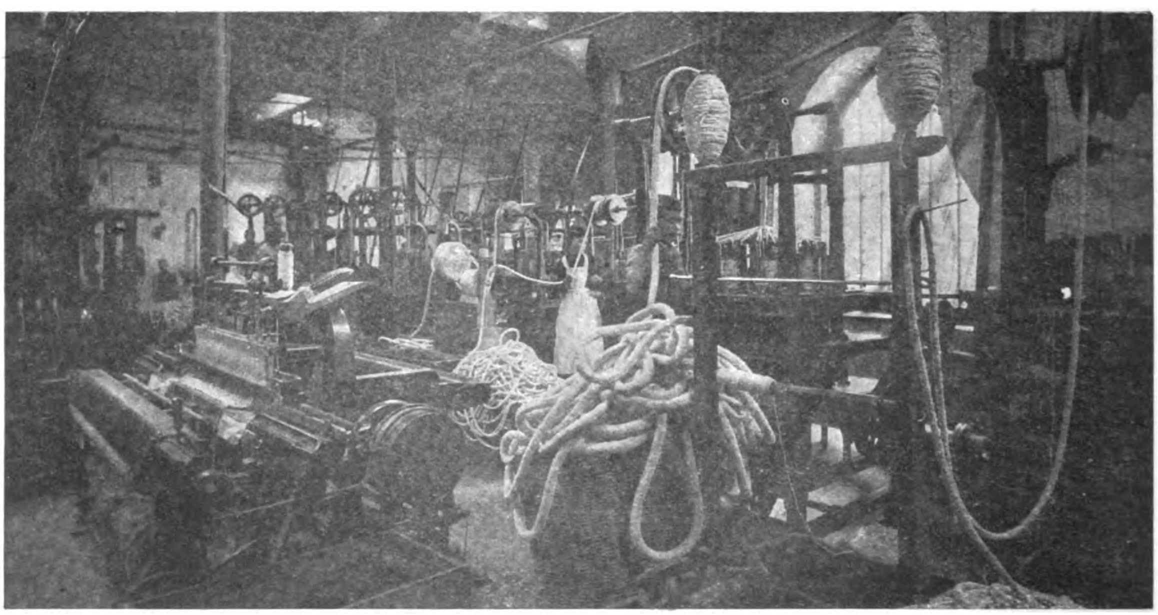
The list of materials dependent for their special utility on the incorporation of asbestos in one form or another is endless, and most of them are of interest to electricians. In the handsome catalogue of the articles manufactured by the New Jersey Asbestos Company are found quotations on asbestos millboard, which is rapidly taking the place of rubber for the packing of dry steam joints; "Carbo-beston," gaskets, paper, asbesto-metallic goods, strengthened by the spinning of fine brass wire into the centre of the threads of both warp and weft, and rendered elastic and waterproof by a coating of rubber solution. Jointings of this material are used throughout the British Navy. Further materials catalogued are, asbesto-metallic sheeting, tape and gaskets, loop and metal-face packing, multiple-core, yarn, woven and wick packings, thread, twine, ropes, tape, tubing and cloth. The asbestos metallic framed curtain, which is now in request for theatres, has been the means of saving more than one building from total destruction. In a fire in a Manchester theatre in 1890, although the auditorium was gutted, the asbestos drop curtain remained intact. The fire beat so fiercely against it that for a long time it was red hot; but it stood staunch, and the whole of the stage, scenery and effects were saved. Asbestos is largely used in the form of cement felting, as a non-conducting covering for steam-boilers, pipes, hot-water tanks, etc., and it also enters into the composition of special brands of cement, putty, powder for the cleansing and polishing of paint, wood, metal, earthenware, etc. The cleansing qualities of this powder are such that large quantities of it are consumed by workmen in removing grease, etc., from their hands, for which purpose it is said to be unique. One of the most interesting applications of abestos is in decorative work. Some beautiful designs in relief are now turned out for friezes, dados, fillings, ceilings, etc. The "salamander" decorations are already placed in large numbers of public buildings, museums, picture galleries, theatres, hospitals, asylums, hotels and private residences. They are found economical, effective and sanitary, besides being, as their name implies, proof against fire.

The factory of the New Jersey Asbestos Co., is at Camden, N. J., and Mr. George Dickson is General Manager. The company also maintains an office at 838 Drexel Building, Philadelphia.

MUNSELL MICA FOR ELECTRICAL PURPOSES.

FEW but the initiated have an idea of the importance and extent of the mica industry. A glance at the elaborate catalogue of Eugene Munsell & Co., miners, importers and wholesale dealers in mica of No. 218 Water St., New York, is sufficient to show that what was at one time a comparatively insignificant branch of the electrical supply business has grown to proportions of great commercial significance. Messrs. Munsell & Co. have, it is claimed, the largest stock of electrical mica in this country, and as they get their supplies direct from the mines, their customers have the advantage of dealing at first hand. The Company's standard price list of cut electrical mica for the current year, just issued, includes between 200 and 800 sizes from 1 x 4 inches to 8 x 10 inches and running from 90 cents per pound to $13.00. The India sheet mica, which is closely trimmed and carefully selected is supplied in several grades and sizes, as is also the amber sheet mica, which has had an appreciable part in building up the reputation of the Company.

Messrs. Munsell & Co. also make a new departure in furnishing mica stamped to exact pattern from the solid sheet, for street car motor commutators, rheostat, and other purposes. This is found to give a great saving over the old methods. The Micanite insulator offered by the company, and now so well known, is made of pure India sheet mica, no scrap or ground mica being used. It is put together in an infinite number of forms, rheostat box linings, taper rings, commutator segments, armature troughs, tubes, rings, washers, bushings, cloth, plates, field magnet spools, etc., and the extent of the resources of the company, indicates that they have taken pains to provide for every possible utilization in electrical work.



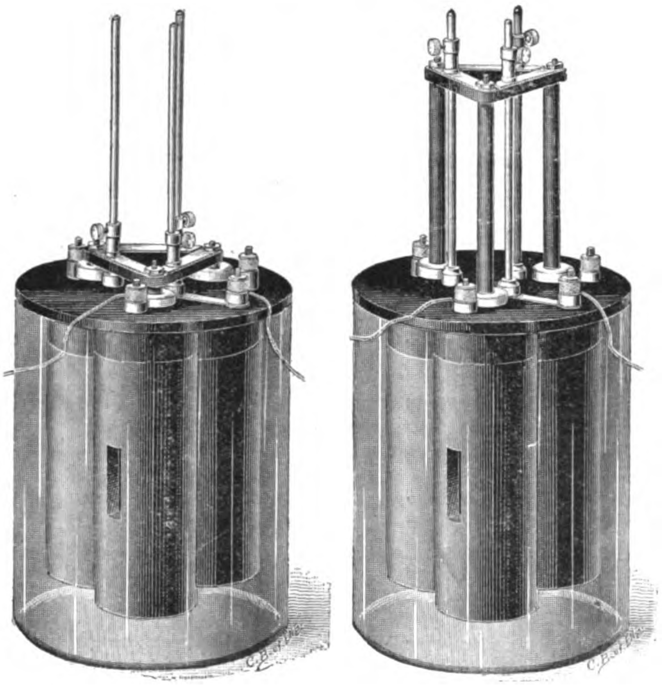
BRAIDING ASBESTOS AT THE WORKS OF THE NEW JERSEY ASBESTOS CO.

THE BOYNTON MULTIVOLT BATTERY.

It has been accepted as one of the canons of electrical science that no matter how large the cell containing the electrolyte of a voltaic battery, the potential difference attainable at the terminals of the electrodes dipped therein always remained the same, that is, equivalent to the potential between a single couple of the immersed metals. Thus it has happened that attempts at increasing the output of batteries have been in the past devoted almost exclusively to increasing the ampere capacity, to the practical neglect of the quest for increasing the voltage. It would seem, however, that a genuine advance in battery work is embodied in what has been called the Boynton "multivolt" battery, named after its inventor, Mr. E. S. Boynton, whose cells we have had the opportunity of inspecting and subjecting to a short test at the works of the Boynton Multivolt Battery Co., No. 10, 12 and 14 Whipple St., Brooklyn, N. Y.

It must be evident that if a number of voltaic couples can be so arranged in an electrolyte that the current, is *compelled* to pass from the positive of one couple to the negative of the next, in succession, in order to reach the end terminals, then the E. M. F.'s of the couples constituting the chain will be added to one another just as are the E. M. F.'s of a group of individual cells, coupled in series, in which the current likewise is compelled to pass from the negative of one to the next positive electrode, in order to complete the circuit.

This directing of the current in the Boynton multivolt cell

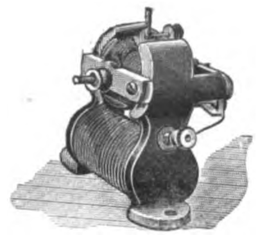


THE BOYNTON MULTIVOLT BATTERY.

has been carried out in a very ingenious manner and will be understood by reference to the accompanying engraving. The cell is of the well known Grenêt type and the one illustrated contains three carbon-zinc couples, immersed in the usual bichromate solution. The zinc rods are placed in the centre of the carbon cylinders and it is on the special treatment of the latter that the action of the battery depends. These carbon cylinders are closed at the bottom and have a perforation in the side which allows the solution to pass through; and the perforations are all directed radially outward so that they are as far apart from one another, as possible. But instead of presenting a continuous surface to the action of the solution the carbon cylinders are covered with rubber on the outside. The effect of this construction will now be apparent. The carbons, presenting an insulated surface towards one another, the current chooses the easiest path by which it can complete its circuit which in this case is from the carbon of one cell through the perforation of its neighbor to the zinc contained therein.

Measurements made with Weston instruments showed that a three-cell "multivolt" battery gave 5¼ volt on open circuit and 5 amperes on short circuit. This cell measured 6 x 8 inches with zincs ⅜ inch in diameter. It is evident that the number of carbon cylinders can be increased at will and hence any desired potential can be had with but a single cell containing the exciting solution. There would seem to be little doubt that this cell is destined to a wide application in the laboratory as well as in commercial work of varied nature. We need only mention that one 6 x 8 cell is sufficient to operate a fan motor for 18 hours with a single charge of solution, to show its wide application in this field alone. Mr. C. H. Brigham, is the business manager of the company.

"BABIES" AND "PREMIERS."



The "Baby."

Mr. R. Rodrigues, 19 Whipple St., Brooklyn. has fallen behind in orders for his well-known batteries and motors to such an extent that night work is now necessary. There has been a large demand for his fan motors in various sizes, and his "Baby" motor for operating mechanical toys has leaped into popular favor at a bound. The batteries, which are known as "Premiers," are keeping pace with the other products. The early arrival of summer has strained Mr. Rodrigues' manufacturing ability, and all who want his products will do well to order promptly.

THE MANHATTAN ELECTRICAL SUPPLY CO.

The Manhattan Electrical Supply Company, of 32 Cortlandt St., New York, make a specialty, they state, of neither manufacturing nor selling any electrical apparatus that infringes valid patents not controlled by themselves. They make a strong bid for telephone trade with their non-infringing instruments for long or short distance service. Their illustrated catalogue No. 7, just published contains also a very full line of signal bells and batteries. One of their specialties is an electric alarm clock with circuit closing mechanism, which can be used in combination with a mechanical alarm attachment, or separate, as desired. With the old style alarm clocks, the sleeper might snore on through the quickly-exhausted alarm call, but when the "Manhattan" clock is set to ring at a certain hour, ring it will and for a couple of hours unless it is switched off. The bell can be placed any desired distance from the clock and battery. Another clock of the same description has the ominous name of the "Slumber-breaker," and the company claim that it can be relied upon to justify its cognomen every time. The catalogue includes a large assortment of push buttons, burglar alarm door and window springs, lamps, thermostats, motors, annunciators, medical apparatus, telegraph sets, speaking tubes, letter boxes, electric gas apparatus, etc.

QUADRUPLE EXPANSION NON-CONDENSING ENGINES FOR THE NEW YORK EDISON CO.

The second of a series of 2,500 to 3,000 H. P. electric generators is now being constructed for the Edison Electric Illuminating Company of New York to be placed in the Elm street station. This generator is to be of the direct-connected type with overhung armatures without outboard bearings. The engine is now being constructed by the Southwark Foundry & Machine Company of Philadelphia, and is to be of the quadruple expansion non-condensing type, and will carry 200 pounds steam pressure.

ELLIOTT BROTHERS' CATALOGUE.

Messrs. Elliott Brothers of 101 and 102 St. Martin's Lane, London, W. C., England, have issued a large and profusely illustrated catalogue of their well known electrical, optical, engineering and mathematical apparatus. The catalogue will be sent free on application, to any address. The book is handsomely bound in stiff covers, and has about 150 finely illustrated pages. The concern are sole agents in England for the Weston instruments. Mr. J. G. Biddle, of Philadelphia, represents them here..

THE METROPOLITAN ELECTRIC CO.

The Metropolitan Electric Company, 186–188 Fifth Avenue, Chicago, reports a good demand for the Dayton electric ceiling fan for which they are the Chicago agents. They have already close dsome nice orders this season. The Metropolitan Company has secured the exclusive agency for the United States for the "Ayer Self Locking Windlass." This windlass has several important improvements and commends itself on first sight to all practical station men.

The Wainwright Steam Appliances.—The Taunton Locomotive Mfg. Co. have issued a very handsome and effective catalogue, quarto size, with 25 cuts, illustrating and describing the various forms of the Wainwright feed water heaters, surface condensers, expansion joints, etc. Supplementing the descriptive text are a number of useful tables, including those which show saving effected by heaters, in fuel and money, for various sizes and different prices of coal. In addition to the familiar standard apparatus for steam plants, the catalogue notes also some special appliances, reheaters, copper gaskets, etc. Altogether it is a valuable compendium.

THE VANCE ELECTRIC CO.

Note was made in a recent issue of the formation of the Vance Electric Co. of New York City, which now has opened offices in the Electrical Exchange Building, 136 Liberty street. The officers are A. S. Vance, president and general manager, and J. H. Cheever, secretary and treasurer, with whom is associated C. A. Allen, formerly of the Dover, N. Y., Electric Light Co. Mr. Vance is particularly well known in the electrical field, which he entered in 1884 when he connected himself with Messrs. Leonard & Izard in Chicago, remaining with that firm till 1887. Mr. Vance then accepted a call from the United Edison Manufacturing Co., New York where he remained until the merging of that company with the Edison General Electric Co, acting as assistant general manager of the Electric Light and Power Department. In the fall of 1893 Mr. Vance resigned his position and joined the H. Ward Leonard Co., as general superintendent, which position he held from the organization of that company until last fall. In this capacity he had charge of all construction work. Among the many installations carried out under his supervision were the 2,800 light plant in the new Home Life Building, and the 3,000 light plant in the Cable Building, New York. He also installed the special signal system of the Metropolitan Traction Co.'s Broadway and Columbus Avenue lines. The Vance Co. will go in for complete plant construction for lighting, both central station and isolated, wiring work of all kinds, electric railway construction and general engineering and contractors' work. The Company will pay special attention to interior effect and private residence and decorative lighting in dwellings, stores and first class buildings. They also undertake complete telephone exchange work.

NEW YORK NOTES.

MR. FREMONT WILSON, the well known consulting electrical engineer and insurance expert, has removed his offices to the Wolfe Building, No. 66 Maiden Lane, New York.

MR. HORACE A. PITCHER, of the Interior Telephone Co., goes abroad on June 15, for a trip of business and pleasure combined, accompanied by his son, Mr. Ray Pitcher, of the New York & New Jersey Telephone Co. They are to tour through England, France and Switzerland.

THE JOSEPH DIXON CRUCIBLE CO. held its annual election on April 15 when E. F. C. Young was re-elected president; John A. Walker, vice-president and treasurer and George E. Long, secretary. The company is the largest manufacturer in the world of graphite products.

MR. A. T. CLARK of the American Circular Loom Co., of Boston, favored this office with a brief call this week, on one of his flying trips to the metropolis. Flexible conduit must be in demand when the genial treasurer of this busy company has to come to New York to attend to business.

JENKINS BROTHERS' STANDARD PACKING.—An old favorite has just entered on another phase of its prosperous career. The "Jenkins" Standard Packing is so well known in the trade that it needs no extended description. Jenkins Brothers have opened the Spring demand with a rush. They are distributing neat samples to the trade.

MR. J. S. SPEER, of the Partridge Carbon Co., of Sandusky, O., was in New York this week looking up his important business interests in this section of the country. Mr. Speer says the demand for the self-lubricating Partridge carbon for brushes is increasing amazingly, and he has just pocketed some important orders in this vicinity, which will keep their factory busy for some time.

MR. E. W. LITTLE, general manager of the Interior Conduit & Insulation Co., made a flying trip along the Atlantic Coast last week, chiefly in the interests of their Lundell fan motors. From Richmond to Boston he found things ripe, and all the agencies reported to him royal sales of this popular specialty. The hot weather and better times are helping a liberal resort to cooling breezes.

PHILADELPHIA NOTES.

THE KENSINGTON ENGINE WORKS, LTD. (Francis Bros.) 704 Arch Street, have issued a pamphlet on their Kensington feedwater heaters and purifiers. It illustrates two plants—the "Pennsy" and the Reading Termini in Philadelphia; and shows also a 60 inch heater made for the Philadelphia Bourse. There is a good discussion in the brochure of what a feed water heater can and should do. The concern are manufacturers, in addition, of the Buckeye engines, &c. exhaust heads, drip and blow tanks, automatic tank pump regulators and a variety of other important specialties in the line of steam use.

NEW ENGLAND NOTES.

WATERBURY, CONN.—The Berlin Iron Bridge Co., of East Berlin, Conn., are building an extension to the casting shop of the Waterbury, Conn., Brass Co., at Waterbury, Conn.

MARBLEHEAD, MASS.—The iron roof trusses and purlins for the new electric light stations at Marblehead, Mass., have been furnished by the Berlin Iron Bridge Co.

KINNEY CONDUITS.—The Kinney Electric Conduit Company has been organized at Portland for the purpose of manufacturing and selling conduit tubes for running electric wires, with $250,000 capital stock of which nothing is paid in. The officers are: President, Frank Fuller, of Boston, Mass. Treasurer, Israel W. Dodge, of Beverly, Mass.

CLINTON, MASS.—The automatic electric door-opener for fire department houses, invented by David F. Latin of this town, which opens the door at the central fire station by pushing an electric button on the hook and ladder truck, has been put in position by its inventor, and works successfully. Mr. Latin has secured patents on the invention.

THE EAST HAMPTON BELL CO., which was established in 1837, and thus antedates the telegraph, has been incorporated during the present year. The concern is making all kinds of bells, from those mentioned by Poe down to the latest form of magneto, and inclusive of house, team, bicycle, sheep, toy and every other. Mr. G. W. Goff is the treasurer of the company and will be glad to correspond with electrical people.

WESTERN NOTES.

THE BIG FOUR ELECTRIC COMPANY has been incorporated at Chicago by Wm. H. Brown, Louis K. Gibson and Henry D. Ames. The capital stock is $200,000.

HAMILTON, MO.—The Franklin Electric Co. of Kansas City, Mo., have completed the arc and incandescent plant here and the lights were started on March 28.

PROF. E. P. ROBERTS, of Cleveland, O., has received the appointment for the electrical engineering of the municipal electric light plant at Bellefontaine.

THE FULTON IRON & ENGINE WORKS, of 538 Jefferson Ave., Detroit, Mich., Millard T. Conklin, general manager, have become agents for the Sprague Electric Elevator Co. for Michigan and Northern Ohio.

THE COLUMBIA INCANDESCENT LAMP CO. of St. Louis, has located its New York office permanently at 1108 Havemeyer Building, and its Chicago office at 1236 Monadnock Building. These are slight changes of rooms, but purchasers of lamps will do well to make note of them.

THE GREAT WESTERN ELECTRIC COMPANY, organized for the manufacture of electric goods, has filed articles of incorporation at Des Moines, Ia. The capital stock of the company is $500,000, of which $200,000 is preferred. The incorporators are L. F. Dyrenforth, T. C. Sullivan, Warren A. Drake, H. K. Gilman, and R. H. Smith.

THE BAIRD ELECTRIC CONDUIT COMPANY, Chicago, is another of the many companies recently formed to exploit some underground trolley or other. Its capital stock is $5,000,000, and the incorporators are F. E. Baird, G. E. Baird and W. H. Craig. The company claims to have been negotiating with the Chicago City Railway Company to build an electric line on Indiana Avenue and one on Clark Street.

BOWERS BROTHERS, of 121 Lake street, Chicago, have issued a neat little folder giving sizes and prices of electrical mica, of which they are importers and miners. The mica is furnished uncut, cut to size, or in stamped or solid sheet segments. The last are gauged to the proper thickness by micrometer calipers to the 1,000th of an inch, and afterward pressed and baked to be ready for instant use. Bowers Brothers are also agents for the well-known Billings & Spencer drop forged copper commutator segments.

CANADIAN NOTES.

THE PACKARD ELEC. CO., LTD., of Montreal, C. C. Paige, manager, in order to increase its output and keep up with orders, has removed its factory to St. Catherines, Ont., where all correspondence should now be addressed. The factory is rapidly being equipped, and meantime all orders will be filled from stock.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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SOME MECHANICAL AND ELECTRICAL FEATURES OF THE CARNEGIE STEEL COMPANY'S BUILDING, PITTSBURGH, PA.

BY

Henry Floy.

Carnegie Building, Pittsburgh.

PITTSBURGH is seldom far behind any other city in that spirit of enterprise which appreciates and appropriates the new and the useful. The advantages of the modern "Sky Scraper" had but to be recognized when energy and capital were ready to duplicate in Pittsburg the colossal structures of New York and Chicago. The Carnegie Steel Company, Limited, have just completed in the City of Pittsburgh one of the finest examples of a modern steel office building in the country. It is of U-form, having a frontage of 120 feet on Fifth Ave., and being 110 feet deep. The building is sixteen stories high and from cellar to the observation roof measures 238 feet. It contains three hundred offices, those from the third to the seventh floor inclusive being occupied by the Carnegie Company, and the H. C. Frick Coke Co.

The building rests upon steel columns supported by steel beam foundations resting on hard shale. The first three stories are of Portage entry sandstone, the remainder being of a "Red Roman" Kensington brick ornamented with terra-cotta. Throughout it is equipped with the latest and most improved devices for promoting the convenience, health and comfort of its occupants. The building is as fireproof as it is practicable to make it, nothing but the doors, frames, floors, etc, made from selected hard wood, being of inflammable nature. The architects were Longfellow, Alden and Harlow of Pittsburgh and Boston, who have also designed a large number of other buildings in Pittsburg, chief of which is the Carnegie Library, just being completed.

Dynamo Room.—The dynamo room in the east front corner of the building is 50 x 40 feet in area, and 18 feet high. Its handsomely tiled floor is 32 feet below the sidewalk. Despite the distance underground, the room is perfectly dry, and the tastefully decorated and brilliantly lighted interior presents a cheerful appearance. In order to drain this and the other rooms situated so far below the surface, it was necessary for the Carnegie Company to practically build a new city sewer through 5th Ave. to Smithfield Street.

Within the dynamo room are located three 75 K. W. Westinghouse "Kodak" outfits, three motor dynamos of $\frac{1}{10}$ horse power each, three return pumps from heating mains and two complete switchboards, the latter placed against the front wall of the building.

The generators are of the standard Westinghouse direct current lighting type, compound wound for 125 volts. Each dynamo rests on a bed-plate in common with its engine, to which latter it is directly connected by means of spring coupling. The generators consist of a circular cast iron yoke, from which project inwardly laminated pole pieces of the highest magnetic permeability. The armature is so constructed as to expose the core and windings as largely as possible to currents of air which are set circulating by the form of winding employed. The coils are so connected to the commutator as to give the Westinghouse type of two circuit winding, which at all times insures even distribution of the current throughout the armature winding. Each machine is equipped with a Westinghouse automatic circuit breaker, which operates to open the circuit in case of over-loads, or may be opened at will by means of a separate circuit controlled by push buttons on the switchboard.

The engines are of the compound single acting type, giving 100 H. P. on 100 pounds steam pressure. The cylinders are, respectively, 12 and 20 inches in diameter with a 12 inch stroke, running non-condensing at 300 revolutions per minute. The space occupied by each engine is only 9 feet 11 inches, by 4 feet 4 inches. The dimensions of the common engine and dynamo bed-plate are 5 feet 5 inches, by 14 feet $10\frac{1}{4}$ inches. The steam is supplied to the engines through 8 inch pipes connected to a 14 inch main. The feed and elevator pumps are of Worthington manufacture.

The motor dynamos are as follows: One of the Lundell type supplying $\frac{6}{10}$ of an ampere at 115 volts and used for testing grounds on the lighting circuits. Two Crocker-Wheeler machines, one used for ringing bells, etc., throughout the building, and capable of reducing voltage from 112 to 3 volts, and another for the telegraph sounders, reducing the voltage from 112 to 16 volts.

Switchboard.—The switchboard is of the standard Westinghouse type, 16′ 5″ in length and 7′ $10\frac{1}{4}$″ in height. It is supported on a heavy channel iron set in the tile flooring, from which rise, vertically, nine panels, each 21″ in width. The board is of fireproof construction throughout and consists of a skeleton framework of angle iron in which are mounted standard marble slabs that serve as bases for the instruments. The marble slabs are secured in position by means of special hook bolts and washers which allow the removal of any individual unit with ease and celerity without disturbing the remaining elements of which the switchboard is composed. The board is finished with a marble coping at the top, brass half tubes along the sides of the different panels and brass T-angle strips for concealing the horizontal edges of the abutting marble bases.

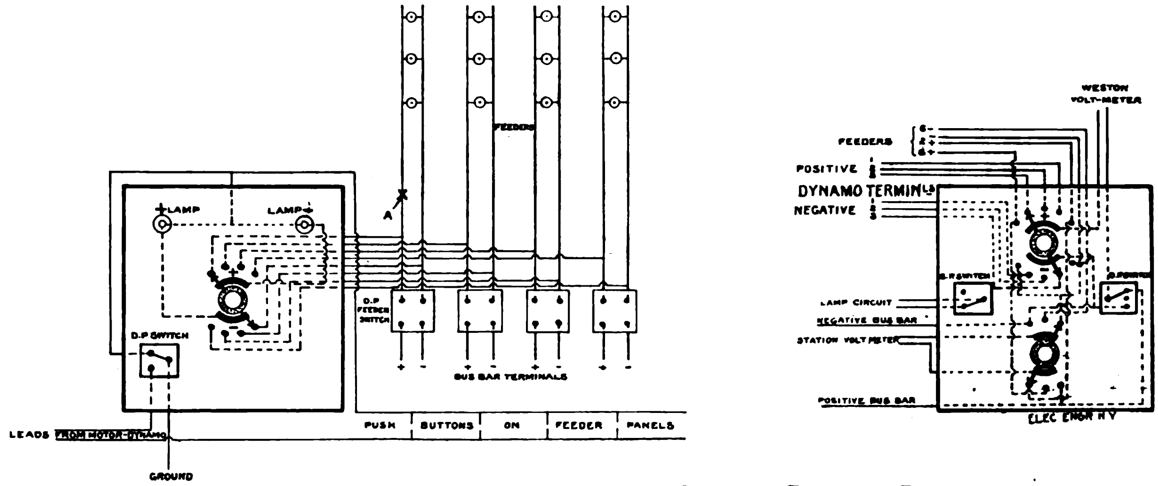
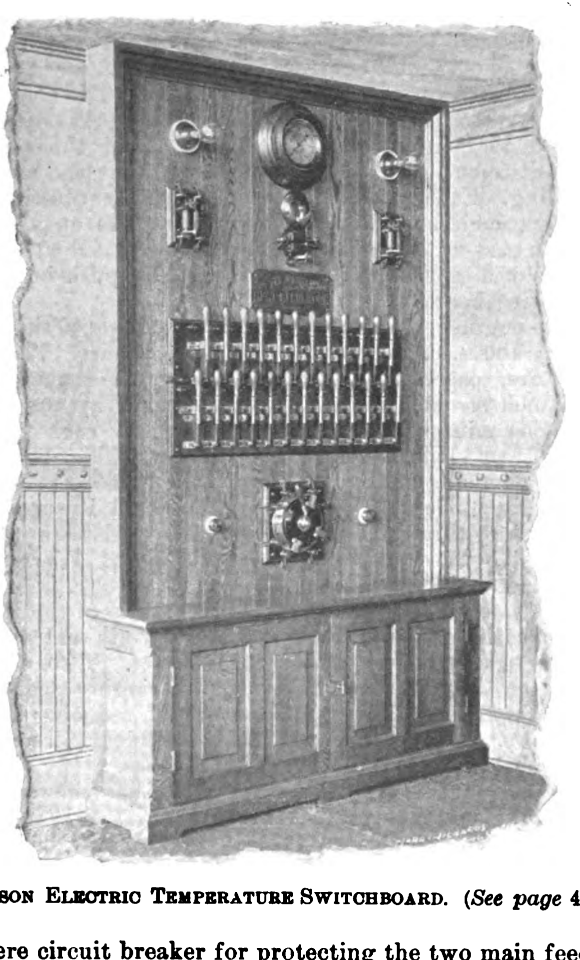


DIAGRAM OF SWITCHBOARD TESTING CONNECTIONS, CARNEGIE BUILDING, PITTSBURGH.

The general arrangement of the instruments on the board may be seen from the engraving on page 457. Alternate units at the top of the board support goose-neck brackets for incandescent lamps. In the "level" (horizontal section) below these are circuit breakers and meters arranged as follows: In the centre, three 600 ampere ammeters for measuring the current from each of the generators; on each side of the group of ammeters, a 1,000 ampere circuit breaker for protecting the two main feeder circuits; outside of these again are two 250 ampere circuit breakers on the two minor feeder circuits. The two end panels of this "level" are occupied by meters. At the end of the board nearest the observer, in the engraving, is a voltmeter to indicate the potential of the feeder circuits at the main distributing points. At the farther end is a 2,000-ampere ammeter which indicates the total current supplied the feeders.



JOHNSON ELECTRIC TEMPERATURE SWITCHBOARD. (*See page* 458.)

The next lower "level" consists of blank marble units except at the centre where there is a Weston illuminated dial voltmeter reading from — 25 to + 125 volts. Below this instrument is a row of switches, the three centre ones being of the triple-pole type and used for throwing the generators in multiple. The four switches outside of these are two pole switches for controlling the feeder circuits. The two end panels are occupied, respectively, by a ground detector switch with plugs, and a very ingenious arrangement, more fully described below, for connecting the Weston voltmeter to any one of the generator or feeder circuits and for throwing the machines in multiple. Below each of the switches at the bottom of the panel is a push button, by means of which the circuit may be completed through a local coil on the circuit breaker, thereby operating the releasing latch and opening the circuit. The three push buttons on the dynamo panels control the circuit breakers which are located on the generators; the other push buttons control the circuit breakers on the switchboard, which are in the feeder circuits. The bottom "level" of the board contains three rheostats, in the three centre panels, for regulating the fields of the generators; the remaining units are blank.

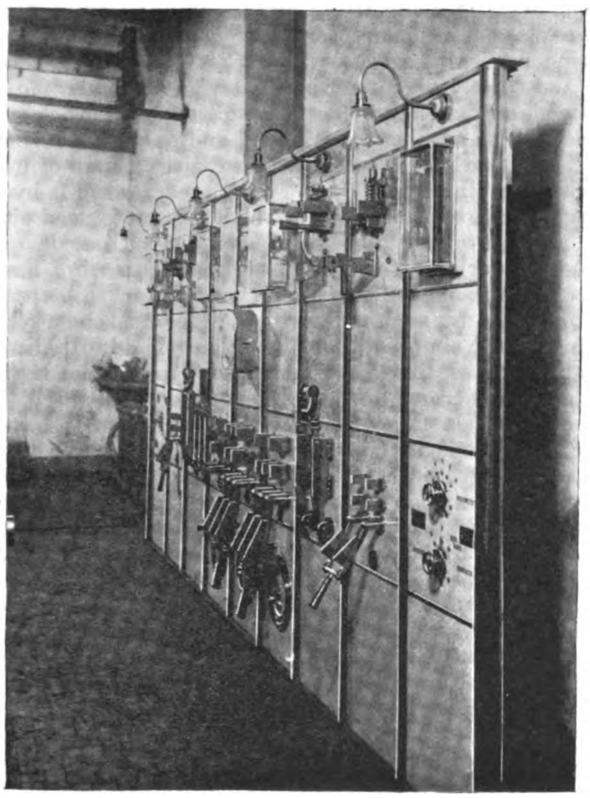
In compliance with the specifications submitted, the switchboard is equipped with four bus bars as follows: The negative bar, the equalizing bar, a positive bar to which the positive generator terminals are connected and another positive bar to which the positive feeder terminals are connected. The two positive bars are connected together through the 2,000-ampere ammeter which is thus caused to indicate the total current supplied by the machines.

The board is equipped with two very ingenious arrangements designed by the capable electrician in charge of the construction of the electrical plant for the Carnegie Co., Mr. J. M. G. Fullman. One, a series of switches and connections, shown on the panel nearest the observer in the engraving of the switchboard, is so arranged that the potential of the feeders may be measured by the station voltmeter or by the Weston voltmeter or by both at the same time, thus affording a constant check on the instruments. Furthermore, the potential of any one of the three dynamos may be read by the Weston voltmeter, or the pressure of the bus-bars may be taken with either of the voltmeters. For throwing a machine in multiple, the pressure of the bus-bars is first ascertained by the Weston voltmeter, then the pressure of the dynamo to be thrown in multiple. After this the machine is thrown in through the Weston voltmeter, which, having a negative reading of some 25 points, is thus made to indicate the difference of potential between the dynamo just thrown in and that of the bus-bars. By varying the voltage of the generator by the field rheostat, the indicator of the Weston voltmeter may be brought to zero; when this is accomplished

the 3-jaw switch is closed, thus throwing the machine in circuit at exactly the correct potential.

The right hand diagram, p. 456, represents dynamo No. 3 in multiple with the bus bars, through the Weston voltmeter, just preparatory to being thrown in multiple with the other machines. The station voltmeter is measuring the potential of the feeder No. 2.

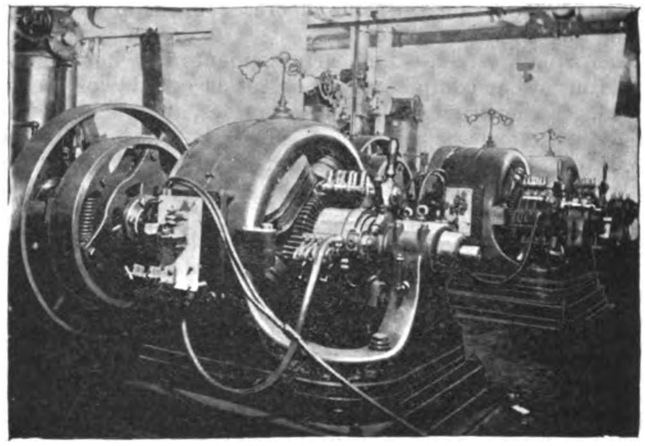
The other ingenious device above referred to, occupies the corresponding unit at the other end of the board; in brief, it is a ground detector, whose connections and arrangements are shown in the left hand diagram, p. 456. When the switches are in the position indicated, a ground on either side of the first feeder, as at A, will be indicated by the incandescence of either or both the lamps marked plus and minus. This test is made in the usual way, while the load is on the feeders, and determines whether there is a ground anywhere on the system. In case a ground is shown, the motor-dynamo is started up and the double-point switch thrown over to its other position, which connects the motor-dynamo ready for testing. The circuits are then opened one at a time, and the test applied by completing the motor-dynamo circuit through the push-button. If a ground is on the circuit under test, the lamps will light; thus in turn each circuit may be tested and ground accurately located without shutting down the plant or disturbing the load on any individual feeder except for a few moments. The chief advantage secured in the use of the motor-dynamo, is that though several circuits may be grounded, a complete test may be made on any individual circuit without its in any way being interfered with by defects in the other circuits.



SWITCHBOARD, CARNEGIE BUILDING.

Boiler and Pump Rooms.—The boiler room is on the same level as, and immediately adjoins, the dynamo room. It contains four boilers as follows: 3 Heine "Safety," one of 250 H. P. and two of 125 H. P.; and one Babcock & Wilcox of 250 H. P. capacity. These boilers are all operated with Hawley down draft furnaces.

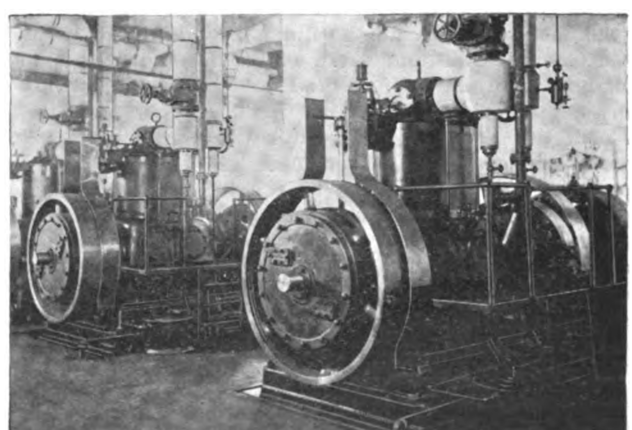
Coal is supplied to the boiler room through two manholes in the side-walk; it is received in a large iron storage vault capable of holding 150 tons. The outlets from this vault are directly opposite the doors of the grates into which it is conveniently shovelled. The feed water heater is of the Berryman type. On the other side of the dynamo room are located together the various pumps for supplying six Otis Bros. hydraulic elevators, running at a speed of 500 feet per minute, the air pressure for the pneumatic tube system, the drinking water for the fountains, etc.



WESTINGHOUSE DYNAMOS, CARNEGIE BUILDING, PITTSBURGH. PA.

Wiring.—All wiring throughout the building, even for the telegraph and telephone service, was done under the supervision of the Carnegie Company's electrician, and no other Company's wiremen are allowed in the building, except for cross connecting in wires at the local telephone and telegraph distributing boards. As a result, the Carnegie Company knows exactly where all its wires are placed, and an inspection of the work shows that it is much more systematic and satisfactory than is usually the case with construction work done by telephone and telegraph companies.

The fuse blocks for each room are placed outside in the hallways behind the marble base-boards. The armored insulated conduits which are installed throughout the building were manufactured by the Interior Conduit & Insulation Company. Two of the four feeder circuits are particularly interesting; they are probably the largest cables in this country, each having a cross-section of 2,790,000 circular mils and being 2½ inches in diameter outside measurement; they were manufactured by Washburn & Moen, of Worcester, Mass.



WESTINGHOUSE ENGINES, CARNEGIE BUILDING, PITTSBURGH, PA.

In order to secure uniform potential at all lamps sup-

plied from these feeders, the following unusual method of distribution is adopted: The positive lead runs to the top of the building, the negative lead to the top and then to the basement again. The lamps are connected between the positive and the "down" side of the negative lead, thus securing an absolutely equal voltage for all lamps, whether located in the basement or on the top floor, as any increase of drop in voltage along the positive main is exactly proportional to the decrease of drop in voltage along the negative main.

Heating System.—The arrangements for heating the building are as complete and perfect as could well be devised. Exhaust steam from the engines, at a back pressure of five pounds per square inch, is distributed through pipes to heaters located in all parts of the building. Reducing valves are also connected with the boilers, so that in case of a break-down or if the engines should not be running, live steam may be supplied directly to the heaters.

The temperature is controlled by the Johnson system of temperature regulation, installed by the Johnson Electric Service Company of Milwaukee. In each room is placed a thermostat connected to which by wires is an electro-pneumatic valve which opens or closes a supply of compressed air that is used to actuate the valves regulating the supply of steam.

The air pressure used is 12 pounds per square inch. In the dynamo room is placed the temperature controlling switchboard. It is equipped with switches, one of which controls the circuit on each floor, where there are three local circuits, each controlled by its own switch. The board is also supplied with an alarm bell which immediately indicates failure of operation in any part of the system; testing instruments, air gauge and rotary changing switch for the two sets of secondary batteries which are placed in the cupboard underneath. Two sets of batteries are installed in order that one set may be charged while the other set is being discharged. In addition to the great comfort and convenience of having the temperature maintained constant at all times, it is claimed that the Johnson heat regulating system saves from 20 to 35 per cent. of the fuel ordinarily used, for heating. The switchboard is shown on p. 456.

The Telephone Service.—In the various rooms throughout the building are located telephones, each instrument being connected with a central board having a capacity for three hundred instruments. From this central, which is located in the basement, lines are run direct to the city exchange of the Bell Telephone Company. As the office of the latter company is within a few hundred yards of the Carnegie Building, there is no necessity for a local exchange as might be expected to be the case where so many telephones are installed.

Pneumatic Tube System.—For the purpose of transferring telegrams and other messages from the various departments of the building to the local telegraph office, there is on the 6th floor a pneumatic-tube "central" connected by means of thirty-one tubes to the various offices. The pneumatic system operates under a pressure of one pound per square inch supplied by means of a pump in the basement. The system was installed by the Miles Pneumatic Tube Company, of Boston.

Telegraph Offices.—The telegraph office contains two repeaters and twenty-two standard sets of instruments. They are arranged about a single long table running the length of the room. A fifteen instrument plug board is installed in one end of the room for controlling the various circuits and making connections with the Western Union offices. The current for the sounders is usually supplied by the one-tenth horse power motor-dynamo in the dynamo room, though by the simple throwing of a two-point switch, the instruments may be operated from the Western Union city dynamos, which thus insures continuity of service. The room is under the direction of one chief assisted by five operators.

Water Supply.—Hot and cold water is distributed throughout the building. The city water is so poor that citizens generally do not drink it without having it purified. The Carnegie Building is supplied with apparatus for successively filtering, boiling, cooling and clarifying its drinking water. On each floor are four drinking fountains to which the purified water is supplied through a system of pipes in which it is always kept circulating by means of a pump. The pipes pass through an ammonia refrigerating tank located in the basement, thus insuring refreshing drinking water uncontaminated by the use of impure ice.

ELECTRO-THERMAL WIRE vs. THE ELECTRO MAGNET.

BY E. R. KNOWLES, E. E.

I have read with considerable interest the article upon non-magnetic electric devices by W. E. Irish, which appeared in THE ELECTRICAL ENGINEER of May 8. While admiring the very ingenious manner in which the electro-thermal wire is made to do service as a substitute for an electro magnet in many forms of electrical devices, the question naturally arises, why, if it can be so successfully and simply operated, such a device has not come into more general use than it has, as a substitute for the electro magnet. The number of practical and operative forms of electrical apparatus in which a tense wire or strip of metal which varies in length by the heat generated in it by the passage through it of an electrical current is used either as a substitute for an electro magnet or not is quite limited, one or two forms of electrical measuring instruments and arc lamps being all that appear to be practically operated by such a device. There must be a reason for this, as the simplicity of the device is admitted without question. I think the answer lies in the fact that all such electro-thermal devices are too slow and sluggish in their action. It takes time for a metal strip to heat up and expand and time for it to cool off and contract, and only under the most favorable conditions and for special purposes will anything like an approximation to the rapidity and sensitiveness of action of the electro magnet be obtained. If the thermal strip is made very long and thin so that it heats and cools rapidly and a very small amount of heat is needed to make a very large change in its length it is possible to use this device for certain purposes, as for instance, in electrical measuring instruments, notably the Cardew voltmeter; but all such arrangements are very delicate in their action, having but little power and occupying a large amount of room. For heavy currents, quick action and compactness, however, it would seem that the thermal strip cannot even approximate in value with the electro magnet, which when you come to look at it carefully, is one of the simplest, most compact, sensitive, rapid and powerful of all electrical devices in use; and it is no wonder that it has held its own for so many years.

There are other difficulties in the use of the electro-thermal strip besides those of sluggishness of action and lack of compactness of arrangement. One of these is the constant variation in length of the thermal strip due to the changes of temperature to which it is subjected, the cold of winter and the heat of summer or other causes; all of which necessitate that either the apparatus must be complicated by the use of some compensating device or that it must be constantly adjusted by hand to keep it in accurate working order. An example of this difficulty which might be cited is its application as the regulating device of an electric arc lamp. Such apparatus is subjected to very great variations of temperature at times, and if adjusted to act properly at one temperature will not so act at another, necessitating constant readjustment to meet the conditions under which it is operating. Another difficulty is the physical change which takes place

in the thermal strip under the action of strain and heat combined. A constant tension on a metal strip has a tendency to change its molecular structure, especially if heated to a high degree, and to produce a dimunition of sectional area and an elongation of the length of the strip as well as to alter the relative resistance of the strip to the passage of an electric current. All of these objections and others which might be mentioned would seem to indicate that while the device is theoretically very simple in its make-up, yet in practice it has grave drawbacks and that these have made its practical applications quite limited in character; and until these difficulties are overcome, its very wide use as a substitute for the electro magnet is not likely to take place and our old, well tried and reliable ally is likely to be with us, an ever present help in time of trouble.

THE THERMO-CHEMICAL CARBON BATTERY.

BY DR. E. HUBER.

In The Electrical Engineer of April 24, I found a short notice concerning the Korda thermo-chemical carbon cell. It may be of interest to record the fact that, about 18 months ago I made several experiments involving thermo-chemical actions between carbon plates and oxygen-delivering materials. I wanted to convince myself whether oxygen in the nascent state brought in contact with carbon would produce a potential difference, that is, a current. I arranged the apparatus as follows:

Two ordinary battery carbons, by means of wires, were connected with the terminals of a Weston voltmeter. Between the plates, peroxide of barium powder was placed in a thin stratum and then one of the carbons heated to a good red heat by means of a Bunsen burner or a blowpipe; whereupon the phenomena described by Mr. Korda could be observed and 1 volt was measured on the instrument. With an area of about 2 square inches a current of 0.2 ampere could be produced, the potential difference being, as stated, 1 volt.

It is, of course, necessary to press the carbons against the stratum of peroxide as much as possible. Later on, I repeated these experiments and showed the results to several friends, who can confirm my priority to the invention.

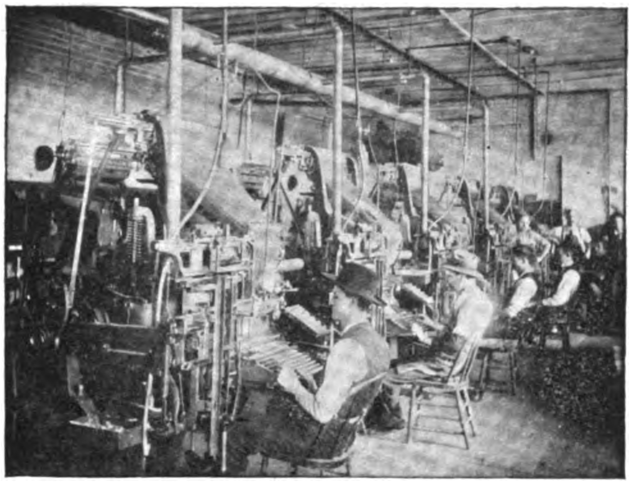
The constancy of the cell is excellent, and the consumption of barium peroxide not excessive.

EFFECT OF LIGHT ON ELECTRIC CHARGE.

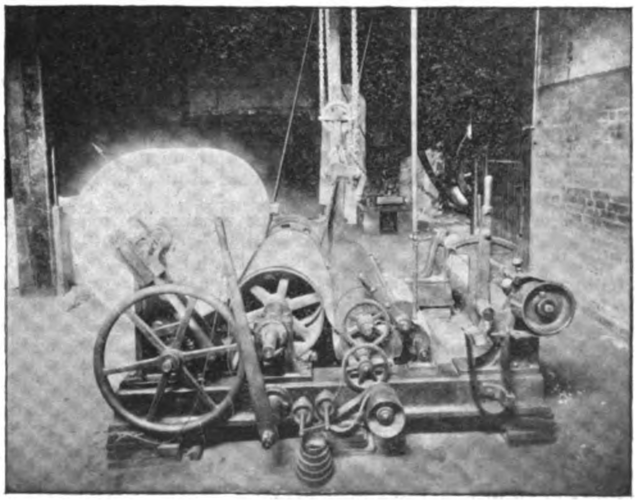
A recent number of *Comptes Rendus* contains an interesting paper by M. Branly, on the rate of loss of an electric charge due to the effect of light in the case of badly-conducting bodies. When the source of illumination is a body heated to a dull red, it is the condition of the illuminating surface which plays the chief part in the phenomenon. The nature of the charged body seems to have no effect. In the case where the illumination is rich in highly refrangible rays, however, the case is quite different, and the chief results obtained are as follows:—A disc of wood or marble, polished or unpolished, shows a marked loss of electricity when illuminated. If the disc is negatively electrified, the loss is more rapid than if it is positively electrified; but the difference is very much less marked than in the case with metal discs, particularly if they are polished. Similar results are obtained with cardboard, terra-cotta, and glass heated to 100°. The loss of a positive charge is rapid, while that of a negative one is slow in the case of varnished wood, or wood coated with a thin layer of oil, paraffin or tallow. With a metal disc coated with tallow, the loss when negatively electrified is slow, while the loss when positively electrified is very rapid. If a disc of polished wood, in which the loss of a negative charge is more rapid than that of a positive one, though the difference is not very marked, has its surface covered with a thin coating of plumbago, the loss with a negative charge becomes much more rapid than with a positive one. A metal plate covered with grease only loses a negative charge very slowly, the rate of loss of a positive charge being rapid. If, however, a thin coating of copper filings is spread over the tallow by means of a sieve, the loss with a positive charge becomes much more rapid than with a negative one. If powdered aluminum is used in the place of copper, the rates of loss in the case of positive and negative charges become nearly equal.

ELECTRIC POWER IN THE PRINTING OFFICE OF THE LOS ANGELES TIMES.

Electric power has become an indispensable element in the modern newspaper office. Without it the enormous editions published on special occasions by some of the dailies would be impossible, and one has only to walk through the premises of any one of the leading metropolitan journals to realize the important part played by electricity in innumerable departments of the work. Many Western papers have fallen into line in this recognition of the advantages of the most economical and efficient power now available, and none more promptly or thoroughly than the *Los Angeles Times*, the important organ on which the whole of Southern California relies mainly for its current news and information. The *Times* is controlled by a company, with a capital stock of $240,000, and with Col. H. G. Otis as president and general manager. Col. Otis, entered the *Times* in 1882, when it was a comparatively humble unit in the journalism of the State; and since then he has been the guiding spirit of the enterprise. The



Electric Motor Running Linotypes, Los Angeles Times.



Electric Motor Driving Machine for Wetting Paper.

present home of the *Times*, which is one of the most complete and convenient buildings of the kind in the United States, was put up about eight years ago. It forms one of the architectural ornaments of the city, having facades of granite, iron and brick, and a tower surmounted with a copper dome. Electricity is used throughout every branch of the work of publication in some form or other, and the electric plant is said to be one of the completest on the Pacific Slope. It consists of one 9 H. P. Edison bipolar motor; one 6 H. P. Edison bipolar motor—both operated from the Electric Railway Co.'s circuit—and one 110-light Edison generator. The 9 H. P. motor is used for operating the wetting machine, and the stereotyping apparatus, and running the generator for lighting the building. The 6 H. P. motor operates the 10 Linotypes. All the work of the office was formerly done by a gas engine.

The lead of the *Times* in thus adopting electric power has proved so stimulating, that every newspaper office in the city is shortly to be equipped with Linotypes and electric motors.

THE PRINCIPLE OF THE SOLAR ARC LAMP.

BY JOSEPH SACHS.

ONE of the oldest and most efficient methods of feeding arc lamp carbons is the well known escapement and rack mechanism. This type of carbon feeding mechanism has been and is to-day being used on a great number, if not the majority, of commercial arc lamps and has many points of particular merit when a slow and delicate feeding is desired, as is the case in interior lamps and those burning on incandescent circuits.

While in the past this type of feeding mechanism has been of more or less complex construction and delicacy it would be difficult to devise a more simple, efficient and positive feeding mechanism of this kind than that which is used in the Solar arc lamp as manufactured by the Solar Arc Lamp Co., of Brooklyn. The particular merit of this lamp consists in the complete absence of all springs, dashpots, counter weights or other elements which are apt to stick or vary the regulating effect.

The peculiar feature of the general outward appearance of the standard Solar lamp is the enclosing case for the mechanism, which is in the form of a spherical covering in two parts meeting horizontally, and above which is a tubular extension, or chimney, which is capped by a hood carrying an insulated hanger. The globe as shown in Fig. 1 is supported on a metal cup which slides on an extension from the lower carbon holder frame, and is held in position by means of a pin on which the cup rests. When it is desired to lower the globe for trimming or inspection, the cup is turned until a small slot permits it to slide by the pin and it can then be lowered to a stop on the lower end of the extension. Where a spark arrester is used, as shown in Fig. 2, it is rigidly attached to the lower half of the spherical cover, meeting the globe at its lower end, and the latter can be entirely detached.

The standard lamp can be used either in or out doors without any additional hoods or coverings. The wires for the lamp come in under the hood, as shown in the illustration, connected to binding posts. Aside from presenting a very neat appearance the lamp is very compact and light.

The interior construction of this lamp as used on incandescent circuits is illustrated in Fig. 3 and consists of a narrow and nearly rectangular frame supporting the mechanism and having a tubular iron extension carrying the resistances, and surrounding the upper carbon rod, and a light frame supporting the lower carbon and globe holder. The rack forming the upper carbon rod passes through slides in the upper and lower parts of the frame and meshes into a pinion on the first spindle of the feeding mechanism, which in turn revolves the escapement wheel which is governed by an escapement pawl, and this entire mechanism is carried in a U-shaped frame, pivoted at its upper ends to a lever which in turn is pivoted from a support in the upper part of the frame, and has attached to its other end a single coil shunt regulating magnet, which is of sufficient weight to over counterbalance the mechanism.

It will be seen that the upward movement of this magnet by its attraction on the fixed armature, when energized, causes a straight line vertical movement in the opposite direction of the feeding mechanism, and as the U-shaped frame slides against a stop at its lower end, the pinion is always held in contact with the rack (upper carbon rod), to which a corresponding movement is imparted, if the escapement pawl is held from vibrating by a stop attached to the supports from which the entire mechanism is pivoted.

The escapement is only released, thereby permitting the upper carbon rod to slowly feed downward by its own weight, when the mechanism has been lowered a certain distance by the raising of the magnet, which is regulated by setting the fixed armature up or down or adjusting the stop of the escapement pawl.

The regulating magnet, whose action on the fixed armature rigidly attached to the lamp frame can readily be understood, is wound with a shunt coil of fine wire connected across the arc, and a cut-out is provided to open the magnet circuit when the rod has reached its limit. This cut-out consists of a small pivoted lever placed on the magnet side of the mechanism supports and making contact at one end with a small copper clip, the other end thereof bearing against a smooth edge of the square carbon rod, so that it is bound to remain in contact until pushed down by a small pin in the end of the rod.

These lamps are generally arranged to burn two in series across 110 to 115 volts. According to the voltage and manner in which the lamps are connected to the circuit on which they are used, a resistance is stretched parallel to the tubular extension, being supported by porcelain insulators at each end; this resistance consists of a coiled spring of Krupp's special resistance wire, which has a number of advantages over the ordinary German silver or iron resistance wire generally used. In interior decorative lamps, like those shown in Figs. 4 and 5, the resistance is placed in a canopy at the top of the carbon rod enclosing tube, and is coiled around a cylinder having porcelain insulators around

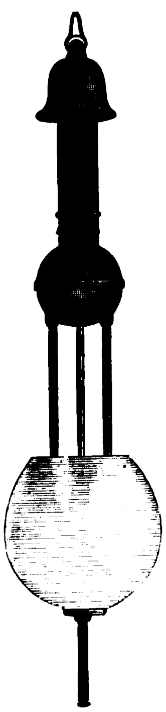


FIG. 1.

FIG. 2.

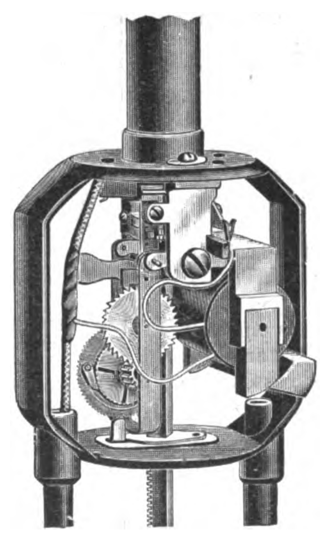


FIG. 3.

FIG. 4.

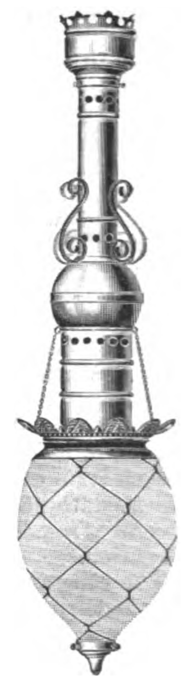


FIG. 5.

THE SOLAR ARC LAMP.

its circumference. The peculiar feature of having the regulating magnet act as its own counterbalance and without any springs or dash-pots makes a most novel, simple and positive arrangement, and the makers claim that this lamp regulates within two and a half volts. Aside from the above features the lamp possesses other minor points of merit, among which the following are to be noted. The carbon holders are adjustable to any size carbons, and the upper is arranged to swivel in a ball socket. In trimming or adjusting the lamp the upper rod can be rapidly pushed up or down without operating the escapement, which is accomplished by having a small friction clutch between the rack pinion and the larger gear on the same spindle.

The Solar Arc Lamp Co. of No. 280 Broadway, New York, has also just completed a lamp of similar construction adapted for use on series constant current circuits, which generally has all the above features excepting the resistance. It is supplied with a cut-out of a somewhat novel construction and operation. This consists of a small compound wound magnet, the shunt high resistance coil being connected across the arc either separately or in series with the shunt regulating coil, and the heavy wire series coil on the cut-out is in circuit with the cut-out by-path.

Normally when the lamp is burning under proper conditions there is not enough current going through the high resistance coil to attract the armature and close the by-path. If the arc, however, breaks or grows long, this current becomes greater, attracting the armature and causing it to close the by-path around the lamp, and through the low resistance coil of the cut-out, which then energizes the cut-out magnet and keeps the by-path closed. A short circuiting hand switch is also provided, the handle of which extends through the bottom of the spherical cover.

The Solar lamps are made in lengths of from 28 to 36 inches, according to the length of carbons, and current used. The standard lamp for incandescent circuits measures 28 inches, burning 9 hours with full length carbons and taking eight amperes. The 36 inch lamp burns 15 hours with the same current.

The lamp is very compact and light and lends itself most readily to ornamental exterior arrangements, and the manufacturers have gotten out a line of most highly artistic designs, some of which are shown in the accompanying engravings.

DEATH FROM LOW POTENTIAL SHOCKS.

BY C. M. GREEN.

Referring to the letter in THE ELECTRICAL ENGINEER of April 24, on an unexplained death from a 280 volt-shock, I wish to make one or two comments. The only reasonable way in which I think this accident can be explained is that the miner got hold of the terminals of the field coils and then the circuit was broken at the generator or back of the motor.

I proceeded to make some experiments on this line as soon as possible after reading the letter, and observed the action upon the field magnets of a dynamo at hand in which the ends of magnet had brass heads and a copper sheath over the iron core which would naturally serve to cut down very much the action to which I refer. Nevertheless the effect was quite marked. I sent a current through the field which gave thirty volts after the current had assumed a steady value. I then reversed the voltmeter at the terminals of the field, breaking the circuit quickly and the needle swung up to 300 volts, or 10 times as high as before. I used a Weston voltmeter and multiplier in the above experiments.

I have assumed that direct current was used in the above but from some observations made still more recently I think the same might occur with an alternating current but with no certainty, depending upon the amount of current flowing in the circuit at the instant the circuit was opened. Frequently I would get no spark to speak of and then a fluffy spark 2 inches long with no certainty of getting it the second time. I regret that in the original letter the motor and plant in general was not more fully described as I could then plot out combinations which would give the above results.

THE PROPOSED PACIFIC CABLE.

Mail advices by the steamer *Miowera*, from Australia, say that the British cable scheme is finding much support in Australia. Large numbers of circulars and financial statements are being printed, tending to show that the cable would pay, and that if Great Britain, Australia, and Canada do not move quickly, America will forestall them. Some of the colonies guarantee, besides a bonus, that trade equal to the entire trade now going over the Asiatic route will be sent by the Pacific route. In 1890 Australians cabled 827,288 words and in 1891 1,275,191. It is guaranteed that in the face of reduced rates 1,150,000 words will be sent by the Pacific route, the receipts for which must be £116,631. The feeling in favor of the Pacific cable is spreading, and not a colony in Australia will, it is said, withhold a bonus.

LETTERS TO THE EDITOR.

ELECTRO-THERMAL DEVICES.

If Mr. W. E. Irish has been able to construct the various devices, containing thermic regulators, and which were described in your issue of May 8, in a commercially successful shape, he must be in possession of great skill and ingenuity. Even the Cardew voltmeter, once a highly esteemed hot-wire instrument, does not seem to have been able to hold its own against magnetically controlled instruments.

WM. HOCHHAUSEN.

BROOKLYN, May 12, 1895.

DROP IN CANDLE POWER ON ALTERNATING CIRCUITS.

In reply to J. F. P.'s letter in your May 1 issue, I would suggest that he try a Weston alternating current or a Cardew voltmeter in the lamp circuit and take readings of voltage and candle power, if practical, during the evening at certain stated times, say, every half hour and also at the station. It may be possible that the change in the frequency changes the readings on his present voltmeter as it will with some, but I do not think it will affect the light of an incandescent lamp over that small range.

C. M. GREEN.

CLEVELAND, OHIO, May 13, 1895.

THE COX THERMO-ELECTRIC GENERATOR.

In the interesting account given in your issue of May 1 by Mr. H. B. Cox on his thermo-electric generator, he states that with one type he obtains from a gas consumption of 2½ ft. per hour, either "½ volt and 90 amperes; 1 volt and 45 amperes; 5 volts and 9 amperes; 2 volts and 22 amperes; 11 volts and 4 amperes." He states the capacity of other generators in a similar way. Does Mr. Cox mean that the volt readings were obtained at the same time that the current readings were obtained, and that therefore the output of the generator is to be taken as, approximately, 45 watts? Or, as is more likely to have been the case, were not the readings in volts open circuit readings when the pile was doing no work, and were not the current readings short circuit readings, when the pile again was doing no external work; for if this be the case the actual watts would be one quarter what he leaves it to be inferred, from the statements he makes, was the value obtained, and the attainable efficiency, therefore, would be much less than his figures would apparently indicate.

R. SHAND.

LYNN, MASS., May 3, 1895.

[We may say in behalf of Mr. Cox that he has been inundated with inquiries of this character since the appearance of our article, and abstains for the present from any reply to criticisms or requests for information. Further data will be published at no distant period.—EDS. E. E.]

SOUTHERN MINERS FIGHTING OVER ELECTRIC POWER.

The proprietors of the Royal Mines, at Coal Creek have been having an unpleasant experience while introducing electricity into the working of their mines. They lately put in electrical machinery for mining and raising their coal, at a cost of $50,000. To operate this plant ten skilled workmen were brought from Ohio and Pennsylania. The old employees at the mine objected to the employment of the new hands and bad feeling arose. Three of the former led by a man named Hendricks, met three of the new comers in the company's store. Hot words were spoken, and Hendricks shot one of the party named Morgan who returned the fire and shot Hendricks dead. Morgan escaped, and was pursued by a party of 35 miners. The miners, 300 in all, went out of the mines, quitting work, and further trouble was feared at last reports.

A PLAN TO DEVELOP ELECTRIC POWER FOR FRISCO.

The *San Francisco Examiner* has offered a prize of $50 for the best suggestion as to what San Francisco should do to acquire half a million citizens. A. G. Wishon, a Californian interested in the Visalia waterworks, proposes that the water of the rivers north of Sacramento should develop electric power, and the power should be offered at the lowest possible rate to manufacturers of every article that requires the turning of a wheel; that the State produce and supply the raw material for these factories, which can be done by reducing the present freight rates to nearly one-third and paying an even, fair price for such products; that every citizen should strive to create a ready and steady market for everything that can be produced in the State, and so attract patronage for every class of trade. Mr. Wishon says: "Reach out for trade on short profits, and look after the interior as you do the city, and the problem is solved. With electrical power generated by waterfalls, interior freights reduced to the minimum, Golden Gate open to the world, results are inevitable."

ELECTRIC TRANSPORTATION DEPARTMENT.

MAGNETIZATION OF STEAM RAILROAD SIGNALS FROM STREET RAILWAY CURRENTS.

BY H. WELLMAN.

A peculiar case of magnetization has been brought to the writer's notice and which he would like to place before ENGINEER readers in the hope of getting at the bottom of the thing. It is the magnetization of the signal levers in a switch house at the crossing of an electric line over the tracks of a steam road. We have a grade crossing on our road, (the Ashland & Catlettsburg Electric

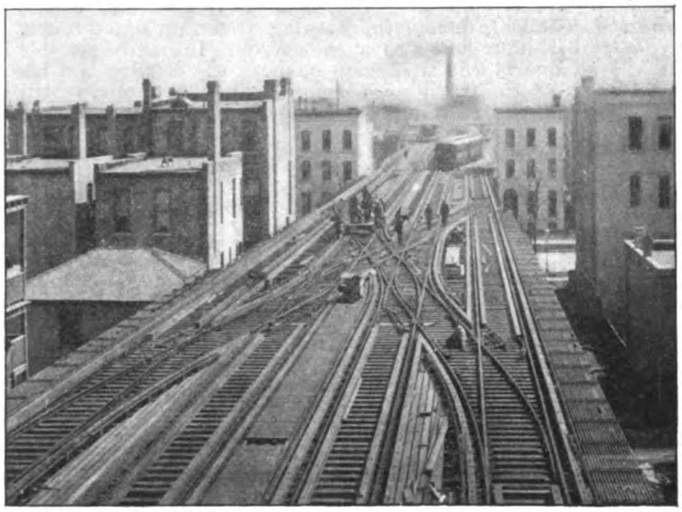


FIG. 1.—METHOD OF TRACK CONSTRUCTION AND RUNNING THROUGH BLOCK.

Ry., of which I am superintendent) at West Catlettsburg, over the tracks of the Chesapeake & Ohio Railway Co., and as a precaution for the safe use of same, the C. & O. R. R. has put in an electrical block system. There are four signal towers, 30 ft. high and two dwarf or home signals; also two derailing switch points, in our tracks, one placed on each side of the crossing, namely, the red or danger signals at a distance of 250 feet from the crossing, while the green or caution signals are each 1,300 feet away.

A switch house has been built at the crossing for manipulating the levers which operate the signals, etc. The floor of this house is five feet above the tracks. The levers in the house are connected to the signals as follows. One lever operates the two dwarf or home signals and the two derailing switches. One operates the two danger or red signals, while the caution or green signals, being at a greater distance from the crossing, are each operated by a separate lever.

These levers extend about four feet above the floor of the switch house and some distance below, and are continually magnetized, but not to the same degree of intensity, being stronger mornings and evenings, and almost entirely inert when current is off the line. The top end indicates north polarity and bottom end south polarity. They are all connected together by a heavy cast iron frame and floor plate through which the levers extend. While only four levers are used in this instance, provision is made for seven should they be necessary.

I attributed the phenomenon due to waste or idle currents, but such a conclusion seems hardly possible considering the excellent means provided for conveying the return or ground current to the power house in Ashland, a distance of five miles from the crossing. Our track parallels the C. & O. R. R. as also the Ohio River the entire distance between Ashland and Catlettsburg. There are heavy castings or plates placed in the river bed at each end of the road, one being at the power-house and the other near the crossing. There are also three heavy castings in the bed of creeks or branches emptying into the river at about equidistant points between the two towns. All these plates are connected to the track by a No. 0 copper wire. In addition to the above, each joint of the track is double bonded by a No. 4 copper bond and cross connected every sixty feet. Our road is single track; while the steam road is double track. The electrical part of the block system which will lock the lever operating the derailing switches after a train enters the distant end of the block, is just being put in and of course could take no part in the magnetizing effect. I have given all the data obtainable so as to enable your readers to clearly understand the conditions prevailing and hope to see a solution of the affair arrived at.

THE CHICAGO METROPOLITAN—THE FIRST PERMANENT ELECTRIC ELEVATED RAILWAY IN THE UNITED STATES.

The success of the first electric elevated railroad in the world at Liverpool, England, has done good service in stimulating Americans to embody in their first road of this type, the best results of modern ingenuity and practice. The Metropolitan Elevated Electric Railway of Chicago, which is intended to relieve the heavy traffic between the business centre of that city, and the immense district lying between the North and South branches of the Chicago River, and known as the West Side, where the population numbers some 800,000, has excited the greatest interest both in this country and abroad. The track has been laid under specially advantageous conditions. (THE ELECTRICAL ENGINEER has already published several articles on the subject, notably that of last week.) It is carried on an elevated structure of steel, and is built over land which the Company has purchased outright, with the exception, of course, of the public streets which it crosses.

Under these conditions the company could virtually select their own line, and this freedom of action enabled them to avoid disfiguring the important thoroughfares by running through the

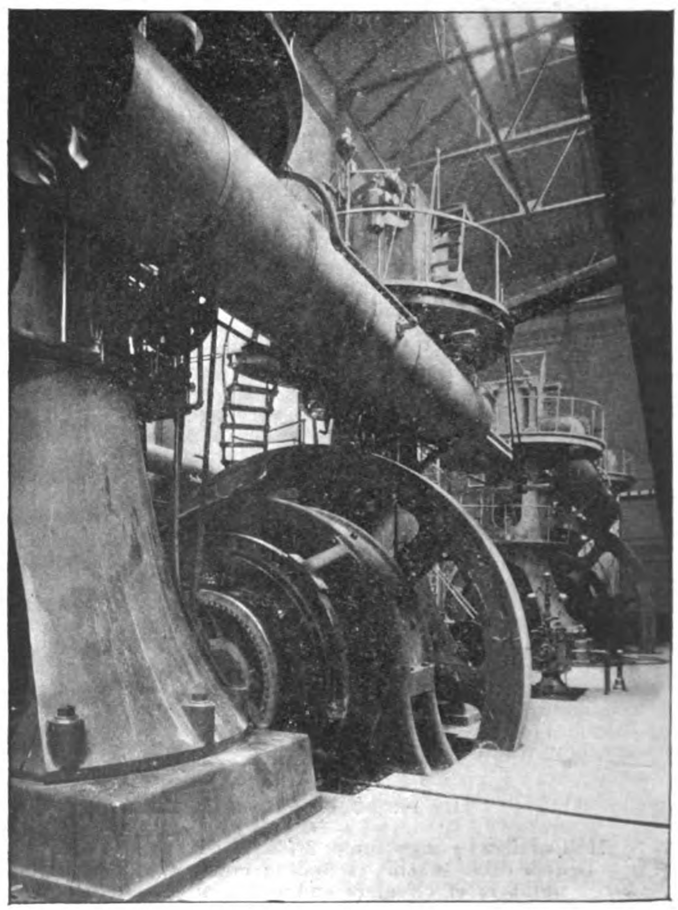


FIG. 2.—VIEW IN THE METROPOLITAN POWER HOUSE.

alleys in the centre of the blocks behind the houses. The road has been built in an exceptionally substantial manner, as will be seen in our illustration, Fig. 1, which shows the third rail running beside the track from which the current is taken by means of a flat metal contact shoe, which hangs down from the car truck, and is kept in contact by a powerful spring. The

track, when completed, will extend 18 miles. On the main line there will be four tracks on which express trains will run, making the journey in five minutes. The power house is situated on the alley behind Throop St., between Van Buren and Congress streets. The leading feature of the station is the generating plant. The generators are of the multipolar type and are direct driven, the armatures being on the main engine shaft. The equipment consists of two 1,500 kilowatt and two 800 kilowatt machines, of the same type as those which were in operation in the Intramural Power House at the World's Fair. These generators are of the Standard General Electric type. The fields are entirely of steel. They are built to stand an overload of 60 per cent. for a short time, and shift from that to no load without sparking at the commutator. Their commercial efficiency is guaranteed to be not less than 94 per cent. One of the large multipolar machines is shown in Fig. 2. The car equipment, as will be seen in Fig. 3, is admirable in every respect. The cars are operated in two and four car trains. The first car of each train is a motor car drawing the "trailers." The motor cars are equipped with two General Electric motors of 100 H. P. each mounted upon the forward truck. These motors are subject to a special controller, which regulates the amount of current supply and the different speed combinations.

The initial car plant is 55 General Electric motor and 100 trailers, but this number is to be increased according to the requirements of the increasing traffic. The ingress and egress of passengers is effected by a sliding door near the gate of the car. The motor car in each train which takes the place of the locomotive is fitted up as a smoking car.

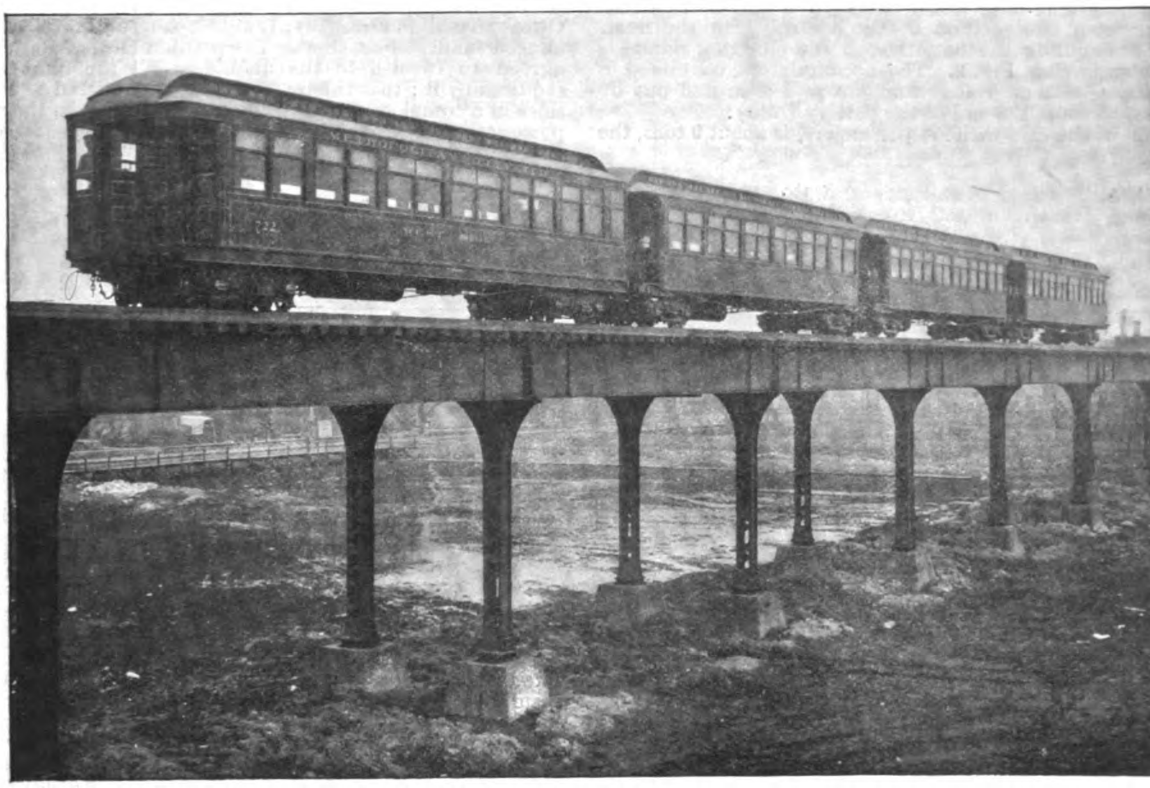


FIG. 3.—TRAIN OF CARS ON METROPOLITAN TRACK, CHICAGO.

A FAST ELECTRIC FROM CLEVELAND TO LORAIN.

Hon. Tom L. Johnson is authority for the statement that an electric railway is to be built at once between his steel plant, at Lorain and Cleveland, a distance of about twenty-five miles. Mr. Johnson says that it will be the fastest electric railway in the world. It is understood that the distance will be covered in a little over half an hour. Few if any stops will be made en route.

AN ENGLISH "OUT-ON-THE-SEA" ELECTRIC RAILWAY.

The Brighton and Rottingdean Sea Shore Electric Tramroad Company hopes to be able to open its new line during the summer, says London *Engineering*. Mr. Magnus Volk the electrician, is managing director. The railway, when completed, will be unique in England and the only other similar line in existence is that at St. Malo. There are two jetties—one at Paston-place, Groyne, and the other at Rottingdean Gap—and at its farthest distance the car will be 800 yards from the shore, but in other parts less than half that distance. The wheels will run on four rails, 20 feet apart, and placed so securely on concrete blocks that it is calculated by experts that no wind pressure such as in living memory has been known on the south coast will have any effect on the car. The car will be raised on a gantry 25 feet in height, so that at high tide it will still be able to run a safe distance above the water. The car will be decked shaped, and there is to be a saloon, with upper deck, so that at high water it will have the appearance of a ship moving slowly along the shore. The car will carry about 130 passengers, and the fare, it is understood, will not be more than twelve cents each way.

ELECTRIC RAILWAY CONSTRUCTION BY THE WHITE-CROSBY COMPANY.

The White-Crosby Company, contracting engineers, of the Equitable Building, Baltimore, Md., and 29 Broadway, New York, report great activity in the several branches of their business. Among their spring contracts is one for the entire construction and furnishing of motors and cars for the Buffalo and Niagara Falls Electric Railway. The road will have thirty miles of track, to be laid throughout with 73 lb. girder rail, in 60ft. lengths, and will have stone ballast. This road connects at either end with the electric roads of Buffalo and Niagara Falls, and between the city limits of these points is expected to make 30 or 35 miles an hour. The company have also closed a contract for 16 miles of "T" rail construction for the Atlantic Highlands, Red Bank & Long Branch road, which includes motors, cars and buildings. This road is to be first class in every respect and will cater particularly for the summer business connecting with the boats from Atlantic Highlands and Red Bank for all the summer resorts between these points and Long Branch.

In Baltimore several contracts are being finished up by the company for the Baltimore Traction Company, including the changing over of one of their cable lines to an electric line, shifting some of their cable track and stringing a large amount of additional feeder wire. They are also finishing up a contract for the City & Suburban road at Baltimore for the erection of 70 miles of No. 0000 feeder wire and about 15 miles of 500,000 circular mils cable.

Other contracts are in hand amounting to about $100,000 with the Baltimore City Passenger R. R., which includes an extension of two miles, for stringing a lot of additional feeder wire from their power house to operate this extension, and giving them increased feeder capacity for some of their other lines.

LA PORTE, IND.—An electric road between this city and Michigan City is one of the probabilities, a franchise having been granted to H. P. Tuthill and A. G. Tillotson of Michigan City.

STORAGE BATTERY CARS IN BERLIN.

Last February there went into operation on one of the lines of the Great Berlin Street Railway Company three accumulator cars, which it is proposed to operate for one year in order to ascertain, (1) the durability of accumulators in street railway work; (2) the cost of renewals and repairs; (3) the nature of the interruptions, if any, in the traffic due to accumulator service; and (4) what energy the storage batteries require.

The batteries in use are of the Tudor type built by the Akkumulatoren-Fabrik Aktien-Gesellschaft Hagen. The line selected for the trial has a total length of 3½ miles. The track is largely on a level, except at certain bridge crossings, where, for a length of 288 yards, the grade is 1.63 per cent., and at another point 36 yards with a grade of 2.5 per cent. The line consists of long, straight stretches joined by a few sharp curves. Two of these accumulator cars are in active service, the third being employed to bring the charged batteries from the line to the charging station, which is about 1.4 miles from one of the terminals of the line.

Each car makes two trips with each battery, covering a distance of 16¼ miles and occupying 3 hours and 25 minutes. Six batteries in all are employed. The cells of each battery are grouped in four series of 22 elements each, and for the purpose of regulation these are grouped in the manner shown in the accompanying diagrams, Fig. 1. The only object of the resistance shown in the diagrams is to avoid the sudden rushes of current when passing from one position of the controller to the next. The method of handling the batteries on the charging stands is shown in the engraving, Fig. 2. The accumulators, contained in shallow boxes, A, rest on rollers and are pulled in and out by means of the lever S at the end of the battery frame.

The weight of the car, without passengers, is about 9 tons, the storage batteries weighing 3.3 tons. The capacity of the battery is 180 ampere hours. Measurements made recently show that for each car mile 1050 to 1110 watt-hours are required; this, taking 1080 watt-hours as a mean gives 17,550 watt hours for 16¼ miles traversed. Taking the efficiency of the accumulators at 75 per cent., the actual energy consumption would be 13,160 watt hours. The mean discharge potential is 175 volts, which would give as the average discharge about 75 ampere hours. As the battery has a discharge capacity of 130 ampere hours it will be seen that it is only drawn on for 58 per cent. of its total capacity.

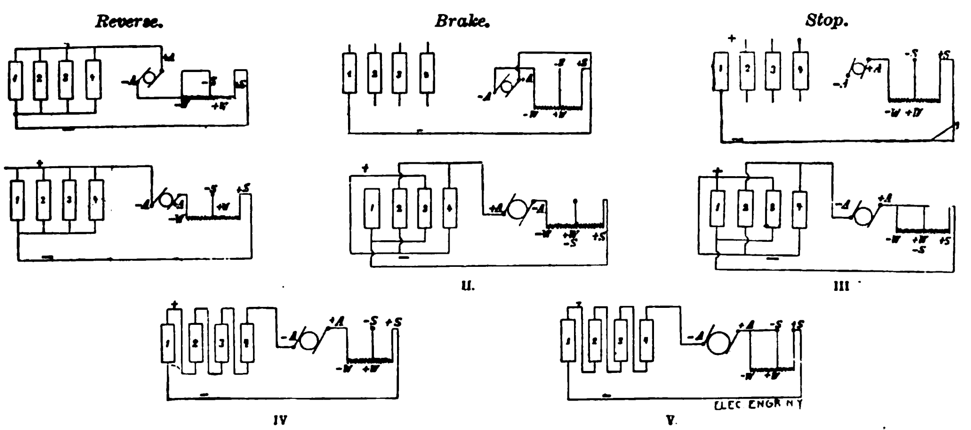


FIG. 1.—CONTROLLER CONNECTIONS, BERLIN STORAGE BATTERY CAR.

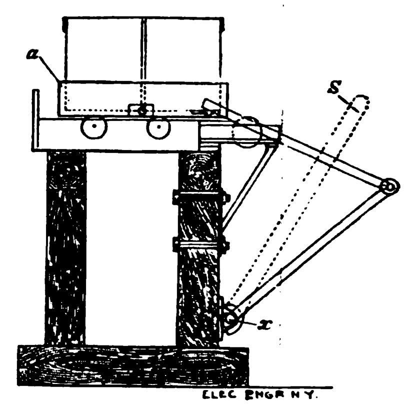


FIG. 2.—BATTERY CHARGING RACK.

TROLLEY SYSTEM FOR THE INDIANA GAS BELT.

The Clodfelter Gas Belt Electric Road Co. has been organized at Anderson with a capital stock of $500,000, for the construction of an electric road to connect the towns in the Indiana gas belt. The contract for the construction of the portion of the road which is to be built at present between Marion and Anderson has been let to the Standard Construction Company, of New York City. The work will begin at these points along the right of way and cars are expected to be running about September 1st. The greatest part of the capital stock was taken by New York capitalists, J. D. Lindsay being the principal one. W. J. Clodfelter has been elected general manager, J. H. Winslow, of Fairmount, treasurer, and J. C. Sullivan, of Summitsville, secretary.

PEORIA, ILL.

THE CENTRAL RAILWAY Co. have applied to the City Council of Peoria, Ill., for a franchise to extend their lines to Glen Oak Park and Springdale Cemetery. They only ask for a permit to build a double track on Abington street for two blocks, the remainder being through their own property.

ELECTRIC RAILWAY PROGRESS IN PENNSYLVANIA.

Mr. A. Langstaff Johnston, the consulting engineer of the Norfolk and Ocean View Railroad, reports that all the work in connection with the change of the road from steam to electricity is well under way. The road is expected to be in operation by July 1st, using 70 lb. T rail with Johnston rail bonds. The 40 ft. cars will be equipped with two 50 H. P. Walker motors speeded to 35 miles per hour. The power house will contain Frick engines, Walker generators, and two 1,500-light Westinghouse alternators, which will light a large hotel now being constructed at Ocean View. This pleasure resort is seeking to further increase its attractions for the coming season by erecting an ocean pier, 1,000 ft. long, the work on which is being supervised by Mr. Johnston. Another enterprise which has been pushed almost to completion by Mr. Johnston is the Fairmount Park and Haddington R. R. The road has about 7 miles of track, which connects with the Hestonville, Mantua & Fairmount Passenger Railroad, by which it has been leased. Power will be furnished by the H. M. & F. road power house, where a 500 H. P. improved Green engine direct to a 400 KW. G. E. generator, is now being put in for this service.

INSISTING ON THEIR CONTRACT.—LOUISIANA ELECTRIC LIGHT CO. vs. NEW ORLEANS TRACTION CO.

The Louisiana Electric Light Company has sued the New Orleans Traction Company, Limited, for substantial damages for alleged failure of contract. The petition alleges that the plaintiff agreed to furnish to the defendant all the light and power required by it; that the traction company agreed to construct its lines in a complete and workmanlike manner, so that the loss of power transmitted through its lines should not be more than the like loss in the best constructed electric railroads, and that the insulation should be kept up to the best standard; that under the contract the traction company was to use in running its cars no more power than was reasonably required for that purpose on lines operated under conditions similar to those prevailing in this city and at the rates of speed allowed by the ordinances of this city. Further, that when incompetent, ignorant and untrained employés in charge of the running of the cars have the control of the power they waste it unnecessarily; that such employés did not properly apply the power and had used and wasted more power than was contemplated under the contract; that the traction company had also put on its cars motors and appliances different from those first used under the contract, and they were such as required the expenditure of much more power.

The electric light company therefore sues for the amount of the power it alleges the traction company wasted under the above conditions.

UNELECTROLYZABLE WATER PIPE.

Experiments are, it is said, being made in London with water pipes made of paper pulp, the object being to provide a pipe which will be unaffected by electrolysis from electric railway return currents. What is the matter with "Indurated Fibre, or with plain Interior Conduit, which is used for salt water conveyance, by the government, because it is the safe and right thing?

RAVENSWOOD, ILL. citizens are reveling in the luxury of a new name. Some days ago the men who manipulated the series parallel controllers of the Lincoln avenue cars pinned a nickel plated badge to their head gear. On the badge is stamped the word "motorneer."

THE COTTON STATES AND INTERNATIONAL EXPOSITION AT ATLANTA.—ITS ELECTRICAL COMMITTEE.

Luther Stieringer.

THE Electrical Committee of the Cotton States and International Exposition to be held at Atlanta this Fall is now bending its energies to the work of organization and administration which it has taken in hand. It is confronted with two separate and distinct problems: first the lighting of the grounds and the interior of the buildings, and furnishing such necessary facilities in the way of power as may be required; second, filling the Electricity Building (see THE ELECTRICAL ENGINEER of Dec. 19, 1894), comprising 22,750 square feet of floor space, with exhibits which will illustrate and indicate as comprehensively as possible the progress made up to the present time in electrical inventions, and their application to practical uses. A great deal of study has been expended on the arrangement of the grounds and the lay of the land with the idea of utilizing to the best advantage the resources at the disposal of this Department, and of bringing out in every way possible the beauties of the surrounding landscape and the architectural effects of the buildings.

The Department expresses its desire of avoiding the pitfall into which so many expositions have drifted. A great deal of

H. M. Atkinson.

J. H. Allen.

lighting of large spaces and extensive ranges of buildings has in times past been wasted because applied at the wrong place, and often in the wrong amount. A great glare of light at certain spots may simply serve to accentuate those localities at the expense of others and so produce a sense of distortion and want

Jas. R Wylie.

C. F. Foster.

of balance. The Department thinks it is so well provided with expert counsel on this point that it will be able to secure the maximum effect of its lighting distribution at an exceedingly moderate cost. The Department is certainly to be congratulated upon having retained the services of Mr. Luther Stieringer, so well known in connection with all recent expositions, as consulting electrical engineer. Mr. Stieringer is now at work on the lighting plans, and his association with the enterprise in such a capacity will create a feeling of confidence in the minds of intending exhibitors and all those interested in the success of the electrical effects of the Exposition. It is understood that electrical fountains of a novel character will be part of these effects.

An active movement towards securing space has already set in among the various manufacturers of electrical apparatus and supplies. The industrial development of the South is one of the most insistent and important factors of the day. Manufacturers

C. A. Evans.

H. E. W. Palmer.

and investors are turning their faces towards that section, and it has already entered on an era of phenomenal growth. There could be no more opportune time than that provided by the exposition to demonstrate the part that electricity can play in all its applications.

The Electrical Committee consists of H. M. Atkinson, president Georgia Electric Light & Power Co., of Atlanta, Chairman; C. F. Foster, well known in connection with the engineering work of the World's Fair, Luther Stieringer, J. H. Allen, editor of "Dixie," H. E. W. Palmer, James R. Wylie, and C. A. Evans. The whole committee is now actively at work.

LITERATURE.

Les Applications Mecaniques de L'Energie Electrique. By J. Laffargue, Paris: 1895 J. Fritsch. 5 by 7 inches. 368 pp.

IN April of last year a publication issued by an electrical firm in France averred that the slowness with which industrial applications of electricity progressed in France was due to the fact that the parties most interested were ignorant of the means and advantages which electricity offered. The assertion appeared to the author to be a just one, and the present work is the outcome of a determination to remove the cause. M. Laffargue has by no means confined himself to the description of the many existing types of motors both continuous and alternating and the use to which they have been put both for stationary work and for electric railways, but has also shown special applications by the score, such as electric machine tools, elevators, pumps, cranes, and the like. He has in addition treated the question from the commercial standpoint, showing by statistics the increasing use of electricity for all mechanical power purposes, not only in France but in other foreign countries as well, giving comparative costs for electric and steam power, and cost of installations, so that the manufacturer is able to estimate at a glance the expense of the change from steam to electricity and the economy.

A special chapter is devoted to the distribution of electric energy in Paris. Compared with our ideas of power consumption, the amount of current employed in Paris for motive power purposes is quite insignificant. Thus the largest quantity devoted to this work is drawn in the Sector Clichy, where 98 K. W. is called for, in a station having a total capacity of 2,050 K. W. The next highest is that of the Sector operated by the Société d'Eclairage et de Force par L'Electricité. This station, with a total capacity of 1,800 K. W. distributes only 26 K. W. in motive power. The total number of electric motors in actual operation in Paris is 142, none of which exceeds 3 K. W. capacity, and the ratio of current distributed in power to the total capacity of the stations, except in one special case, does not exceed 4.7 per cent., and in one case is as low as 0.15 per cent. Whether this is due to a lack of appreciation of the benefits of electric motive power, or whether the price charged is considered excessive, is an open question. On the latter point, we note that in the Sector Clichy the cost per K. W. hour is 0.61 franc, with varying discount according to the nature of the work, and this seems to be the most general rate. The price corresponds very closely to that in vogue in the United States, and hence we might trace the cause for the slow introduction of electric motive power in Paris to conservatism, rather than in other directions.

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CONTENTS.

GERMAN CENTRAL STATION STATISTICS.

No one will accuse the Germans of precipitancy in anything, and hence the condition of the electric light and power industry in that country may be fairly considered to represent the result of deliberation and forethought and the outcome of the most approved practice. The latest statistics on the electric supply stations in Germany, as exhibited in the accompanying tables, reflect

Table I.

System.	No. of stations.	Output of dynamos (kilowatts).	Capacity of batteries.	Total capacity of station.
Continuous current with accumulators........	80	14,388	4,459	18,847
Continuous current without accumulators.....	40	11,631	....	11,631
Alternating current.....	15	4,208	....	4,208
Three-phase system...	8	2,858	....	2,858
Combination systems:—				
Three-phase and continuous current..........	2	646	32	678
Alternating current (generated) continuous current (distributed)......	1	99	98	197
Continuous and alternating current..........	2	76	....	76
Total... ...	148	33,896	4,589	38,485

Table II.

Motive power.	Number of stations.	Total output of dynamos (kilowatts).
Steam........	80	27,290
Water........	44	3,938
Gas........	5	265
Compressed air........	1	14
Electric motors........	3	126
Combinations:—		
Water and steam........	11	893
Water and gas........	1	30
Steam and gas........	3	1,451
Total........	148	33,897

in a striking way the drift of the art in that country. It is apparent that the continuous current has more than held its own, embracing, as it does, 80 per cent. of all the stations now in operation in that country. But still more striking, perhaps, is the showing made by the storage battery, which, it will be noted, is employed in 80 out of the 120 continuous current stations. Any one who has been abroad will concede that the Germans are good electrical engineers, and hence the large and increasing application of storage batteries to central station work must be taken as an indisputable proof of the value of this appliance. We are quite prepared to hear the old argument against the use of the storage battery as applied to American central stations, based on the fact that the loads on our stations are different in nature from those abroad; but we venture to say that a very large percentage of American central stations have precisely the same load diagram as the German central stations, and that they could profitably employ storage batteries.

Another interesting point brought out by these statistics is the growing number of the three-phase stations, which, both in number and in the capacity of the dynamos, already exceed more than 50 per cent. of the like number and power of stations operating with the single-phase alternating current. This is most significant and indicates that the polyphase system is slowly but surely forging ahead. We remark, however, the entire absence of

two-phase installations. When the increasing application of this system in the United States shall have afforded some means of comparison with the three-phase, we shall probably be able to note some changes in these figures in such work. It is also interesting to note that of the 33,896 kilowatts total capacity of the stations, 5,635 H. P. is devoted to the operation of motors, which is very good, taking into account that more than one-half of the total number of stations in Germany have an output of under 100 kilowatts, and that only 20 can really be called large stations. Table II., indicating the nature of the power employed for driving the dynamos shows a comparatively large application, proportionately, of water power, though the total output of power as compared with steam is small. It is interesting to note, also, that there are connected up in Germany half a million 50-watt lamps and over 12,000 10-ampere arc lamps, which would seem to indicate that there is still an enormous field for development of the industry in Germany, judging from the standpoint of the utilization of the current in the United States.

THE RESURRECTED BERLINER PATENT.

On May 18, the United States Circuit Court of Appeals at Boston handed down its decision in the appealed Government suit against the American Bell Telephone Co., involving the Berliner microphone patent, reversing the decision of Judge Carpenter and ordering the dismissal of the bill against the Bell Company. To say that this action created surprise in the community, both electrical and lay, would but faintly convey the feeling which is everywhere manifested at this unlooked-for turn of affairs, although it is said that those who listened to the arguments on appeal were not unprepared for the announcement The opinion giving the reasons for the decision of the Court of Appeals has not been written and will probably not be forthcoming for several weeks; and hence we can only judge of its nature by inference. That the view the Court of Appeals has taken of the evidence and of the merits of the case differs radically from that of Judge Carpenter is obvious. The latter, it will be recalled, held that the Berliner patent was void on two grounds: First, in that the patent in suit, issued Nov. 17, 1891, No. 463,569, was identical with one issued to the same inventor Nov. 2, 1880, No. 233,969 and hence was void (*Miller* vs. *Eagle Mfg. Co.*, 151 U. S. 186); and second, that the issuance of the patent was unlawfully delayed in the Patent Office. It will be noted that these points involve not merely questions of fact but those of law; and hence their importance in view of the probable appeal of the case by the Government to the U. S. Supreme Court. To some hasty people, judging very superficially, it might seem an easy matter for the Bell Company to obtain injunctions against users of microphone transmitters embodying the principle enunciated in the first claim of the Berliner patent which reads as follows:

> The method of producing in a circuit electrical undulations similar in form to soundwaves by causing the soundwaves to vary the pressure between electrodes in constant contact and thereby increase and diminish the resistance of the circuit, substantially as described.

But is the Bell Co. as strongly intrenched as it was before the Bate decision was rendered, last March, invalidating the Edison patents covering the *use of carbon* in microphones? With this material thrown open to public use by the Bate decision, rendered since the Berliner was heard, it is the opinion of not a few that an entirely successful telephone transmitter can be designed which does not come under the claim of Berliner above quoted. Indeed there are several excellent transmitters now on the market to which that claim, in the opinion of those competent to judge, does not apply. It may also be of interest to point out that Berliner, through his agent Lake, took out a British patent, No. 91, of 1880, for a microphone *in which a movable electrode is held against a stationary one by gravity*, which patent expired in 1894. Whether the claim of the Berliner U. S. patent of 1891 would be held to cover this form of instrument patented in England and now expired and free to the public is, to us, quite doubtful. Whatever be the result of the appeal in the Government case, we feel certain that the progress of telephony in the United States will not receive any serious check from the recent decision. Recourse can always be had to the magneto telephone, which had already been brought to a high state of perfection until its use was rendered unnecessary by the decisions of Judge Carpenter and that of the U. S. Supreme Court in the Bate Case. While the decision of last week complicates the situation, it does not appear to narrow the telephonic field of opportuntity in any essential particular.

As to the appeal to the Supreme Court, we must confess we have little faith in that, as things stand. Such an appeal is only possible in a very limited manner, the Circuit Courts of Appeal having been created expressly to relieve the Supreme Court of the pressure of such patent litigation. As we understand it, the Supreme Court can, if moved thereto, send down for the record in the case and review it. But such a motion can only be made by Attorney General Olney; and, in view of his public relations to the Bell interests it would possibly be very hard for anybody to convince him that it was vital and important enough for him to go to the Supreme Court with such a motion. Of course, if he went, he would doubtless get it; but our readers can determine for themselves what the prospects are. The only other way is that the Circuit Court of Appeals might itself find a point of law involved beyond its power of determination, and itself certify the case up to the Supreme Court; but the recent decision renders such an act highly unlikely. The Court of Appeals has practically held that the *Miller-Eagle* case does not apply, and that the American Bell Co. in seeking to get its Berliner patent through the Patent Office was the model and exemplar of virtuous diligence.

Granting, however, that no appeal is possible or comes, the question again arises: What is the patent intrinsically worth to the owners? It still has to be tested as a weapon for worsting "infringers;" and that ordeal has proved pretty severe of late years to even the best of patents. In the Berliner patent is shown a device of a metal ball and a metal plate—not carbon—which device, we are informed, on the best authority, is no good in practical operation. Now, as in the Sawyer-Man filament case, the Courts have held more than once that such a patent, based on a device, however ingenious, of no practical or commercial value is of no merit as a means of controlling a field of work, in which other inventive genius has found other, practical and better ways of doing the thing. This is assuredly the drift of modern patent decisions; and it seems both fair and righteous.

ELEVATED ELECTRIC ROADS.

In view of the fact that the Intramural Road, at the World's Fair, operated on the third rail method, carried nearly 6,000,000 paying passengers with perfect safety and success, we need not wonder at the rapid adoption of the system for one of the permanent elevated roads in Chicago. The importance of the work is such that we have not hesitated to devote several articles to it; and in this issue we furnish further data in regard to this fine piece of electrical engineering. Now that Chicago and Liverpool are thus equipped for rapid transit, New York can well afford to fall in line. It is no mere novelty that appeals to her timid conservatism, but a tried and proved advance in the arts. The continued use of steam on the elevated roads is an anachronism that has not even economy to excuse it.

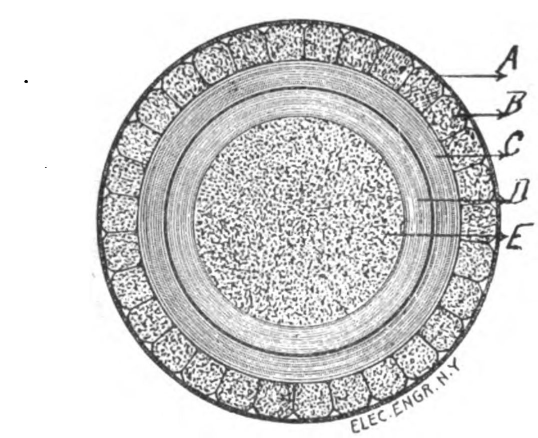
Telephony.

THE MUENCH TELEPHONE REPEATING COIL.

Most long distance telephone lines are now operated with metallic circuits, but not all local exchanges are operated on that system. In order to connect two subscribers in distant cities when these conditions obtain, it becomes necessary to insert at the exchanges repeating coils which transfer the impulses from the main line into the grounded city circuits. It has been observed, however, that, for some reason, in spite of the employment of the metallic circuit, disturbing noises occur, which are attributable to variable differences of potential created between the two ends of the long distance metallic circuit, and especially between the grounded ends, and that the repeating coils connecting them possess a certain electro-static capacity, as occurs with repeating coils wound on the bifilar system. The repeating coils then act as condensers which react on the subscriber's local circuit and bring about disturbing sounds.

To avoid these and other disturbances, Herr Muench of the German postal-telegraph service, has designed a repeating coil, shown in transverse section in the accompanying engraving, which he recently described before the Berlin Electrotechnical Society. This new coil, introduced in the postal-telegraph service, consists of an iron core E, 13 cm. long, 8 cm. thick, built up of wires covered with shellac, and evenly annealed. Over the core, which is covered with paper, there is wound the primary coil D, which is connected to the subscriber's line. This is covered by a double sheath of paper, and over this is wound the secondary coil C, connected to the metallic long distance circuit.

Each winding consists of approximately 4,000 turns of 0.2 mm.



Muench Telephone Repeating Coil.

wire, insulated with silk and wound in 10 layers. In order to increase the action of the repeating coil, it is surrounded on the outside by bundles of fine iron wire B, 0.5 cm. thick, laid parallel with the core.

The resistance to battery current is approximately 200 ohms in the primary and 250 ohms in the secondary coil. For alternating currents, however, the coils show considerably higher resistance depending upon the number of alternations. Tests made with a small alternator giving 2.5 volts at the terminals showed that by varying the periodicity from 350 to 700 (in acoustics corresponding to the soprano register), the apparent resistance of the primary increased as follows:

	Increase.
(*a*.) With secondary winding open,	from 5,500 to 12,000 ohms.
(*b*.) With the secondary winding closed through 500 ohms,	from 910 to 940.
(*c*.) With the secondary winding short-circuited on itself,	from 460 to 490.

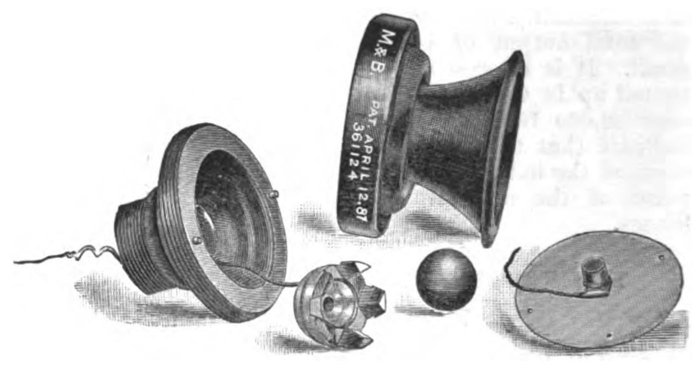
The self induction of the primary winding varied during these tests as follows: (*a*.) from 2,240 to 24,440 henrys; (*b*.) from 0.081 to 0.047 henry; (*c*.) from 0.042 to 0.040 henry. The electrostatic capacity between the two coils is extraordinarily small, the mean of a number of measurements showing 0.00185 microfarad. The tests have shown that even a trained ear is not able to distinguish any difference in the transmission, whether the coil be inserted in circuit or not. When such repeating coils are inserted at both ends, a barely perceptible diminution of the sound is apparent. Comparative tests give the relative values of such transmission in the ratio of 95 to 100; two coils being in circuit, this would show an efficiency for each of between 97 and 98 per cent.

THE "M. & B." TELEPHONE TRANSMITTER.

We are enabled to supplement the description given of this transmitter in our issue of April 17, by the accompanying illustration showing the same dismantled.

The diaphragm is of India mica, and has attached to its centre a small aluminum cup holding a carbon or other suitable point. In front of the black rubber shell is shown the basket or runway of aluminum or other metal. The sphere shown in the cut may be of carbon or other material, $\frac{11}{16}$ of an inch in diameter which normally lies in the basket or runway, and is so constructed that no matter which side of the transmmitter is up, the sphere rests on a plane which is always inclined towards the diaphragm.

When these parts are assembled the point on the diaphragm



"M. & B." Telephone Transmitter.

comes about on a level with the centre of the sphere, which, owing to the angle of the side of the basket or runway, is kept against this point by gravity. The distance between the point on the diaphragm and the back of the basket is about $\frac{3}{4}$ of an inch, which allows the sphere a maximum movement of a little under $\frac{1}{16}$ of an inch.

With every oscillation of the diaphragm a movement of this sphere takes place which breaks the battery current, hence the name "M. & B." standing for make-and-break. With this construction the electrodes are not in constant contact, and it is claimed that an intermittent or pulsatory current is produced instead of the undulating or vibratory, as in the ordinary form of transmitter.

While the volume of sound is great, there are no sputtering, snapping or "frying" sounds. The instrument is also particularly adapted for long distance transmission as it will stand a heavy current without "breaking up." Besides, the instrument requires no adjustment.

The U. S. Telephone Construction Co. of the Bullitt Bldg., Philadelphia, control the "M. & B." transmitter patents.

TELEPHONE NOTES.

Concord, N. H.—The Concord & Montreal railroad is establishing a telephone system at the principal stations on its route, for the use of employees in facilitating the transaction of business.

Waterloo, Ill.—The County Board has granted Drs. S. C., and S. S. Skeel and John A. Jakle, of Harrisonville, the right to erect a telephone line from that place to Waterloo, on condition that said line shall be up and in operation before the expiration of the next 12 months.

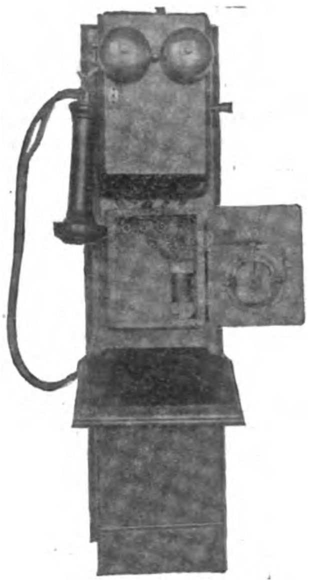
Eureka, Cal.—The stockholders in the Alton Ferndale telephone line have incorporated under the name of the Humboldt Telephone Co, with the capital stock placed at $5,000, the principal place of business being at Ferndale. The officers are as follows: H. H. Moller, president; C. A. Eastman, vice president; G. C. Barber, secretary; G. M. Brice, treasurer, and F. W. Luther.

Fresno, Cal.—A strong company is being organized here to put in a competing telephone system in opposition to the Pacific Telephone and Telegraph Company. The directors are Alexander Goldstein, Arthur Dinkelspiel, Sam Woldenberg, W. W. Philipps and Frank P. Wickersham. It is proposed to reduce the charge to $2.50 a month.

Cincinnati, O.—The Bell Telephone Company has signed the contract for the conduit work laid out for the spring. The present conduit system will be at once extended. In the summer work will be done Over the Rhine and along Hunt street. In all, the company will spend this year $100,000 in extending its conduits.

The Mount Vernon Telephone and Messenger Company has been formed to operate a line of electric telegraph or telephone to connect the towns, villages, cities, or other places within the County of Westchester, N. Y.; capital, $40,000; directors: Horace Granfield, C. H. Ostrander, F. T. Davis, G. H. Gray, John Dawson, John Berry, and William Archer of Mount Vernon.

THE KUSEL TELEPHONE TRANSMITTER.



Kusel Transmitter.

Among the many types of telephone transmitters that have recently been put upon the market, the carbon microphone made by the D. A. Kusel Telephone Manufacturing Company, (Kroell & Meysenburg, 710 Commercial Building, St. Louis, representatives) seems to be one of the most simple and at the same time very efficient.

As our illustration shows, a carbon diaphragm is held by a detachable clamping ring in a circular diaphragm holder. Suitable projections or lugs in the clamping ring are provided, against which two or more clamping screws in the holder impinge, thereby holding the diaphragm firmly in position. Against the centre of the diaphragm rests a carbon button having considerable contact area. This button is attached to and suspended by an over-hanging, pivoted arm, the point of suspension being above and forward of the diaphragm. This gives the button just enough pressure, by gravity, to obviate all springs or other means of pressure between the two electrodes, consequently there is nothing to get out of adjustment. The face of the diaphragm is protected against mechanical injury by a wire netting.

Recent trials of the instrument showed that it would transmit speech over any length of circuit up to 500 miles, without any change in adjustment being necessary.

THE DANBURY TELEPHONES.

The Danbury Electrical Works, Danbury, Conn., and 143 Liberty St. New York, are introducing a complete line of telephones, for long distance, local exchange and long and short private line work. Their "Russell No. 40," shown in the accompanying illustration, Fig. 1 is a carbon instrument expressly constructed for long distance and heavy exchange service. The bells are designed to ring through 10,000 ohms. The transmitter is of the Hunning type with granular carbon and in order to insure good continuous contact, the diaphragm as well as the backplate are made of silver.

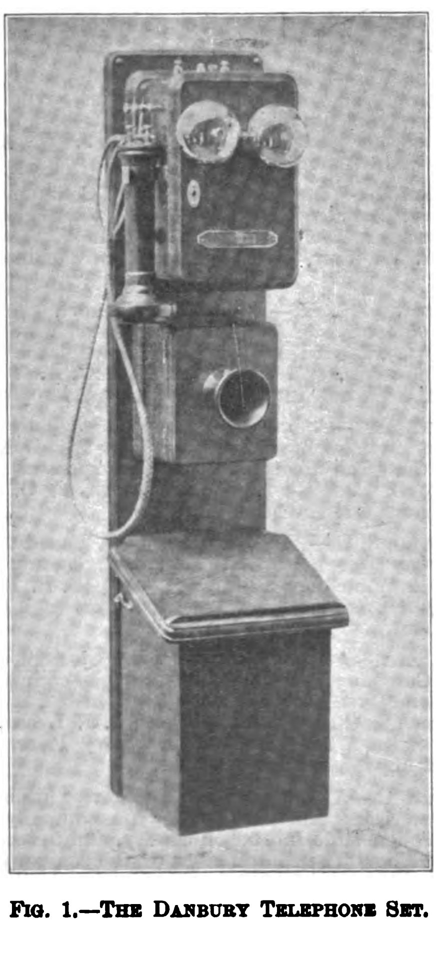


Fig. 1.—The Danbury Telephone Set.

The "No. 25" instrument, intended for local exchange and long private line work, is also fitted with granular carbon transmitter. To its 20 inch back board is attached a bell-box containing 6,000 ohm bells and a desk top battery. The "Angle Phone," shown in Fig. 2, has the receiver and transmitter in one piece and is designed for office work. When the receiving end is placed to the ear the transmitter comes directly in front of the mouth, so that one hand is entirely free to write the message being received, if necessary. It is claimed that by this arrangement much of the fatigue of carrying on a telephone conversation is saved. The firm are also manufacturers of all kinds of telephone central office instruments, and especially central office switchboards. They use in their "universal switch system" the "universal" drop, which is a well finished and reliable annunciator. In conjunction with this they employ a new form of lever switch jack, and an improved system of plugs, cords and weights. These boards are provided with a night bell attachment, and, where required, with keys for looping in the power generator. The company also supply the Hayden carbon porous cup cell, and the Mesco dry battery.

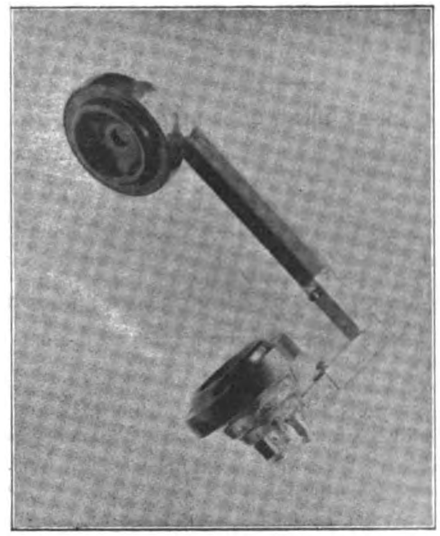


Fig. 2.—The Danbury "Angle" Telephone.

LEGAL RATES FOR TELEPHONE SERVICE IN NEW YORK.

Justice Ingraham in New York Supreme Court Chambers heard arguments last week on the application of Simon Sterne for the continuance of a temporary injunction obtained by him against the Metropolitan Telephone and Telegraph Company restraining it from cutting him off from its service because of his refusal to pay an increased tariff of $240 a year. J. Alexander Beall, with William B. Hornblower of counsel appeared for the motion, and Melville Eggleston and James C. Carter in opposition. Mr. Beall for the motion said that the defendant's business is that of a common carrier of oral messages, and is therefore subject to the legal supervision exercised over common carriers. The only ground given for raising the annual cost of telephone service to the plaintiff from $120 to $240 was that his service had been changed from an overhead wire service to an underground metallic circuit service. He then read statistics showing that in London, in European cities, and places in this country, the price of such service is much less than that charged in this city. Mr. Beall began to read from testimony offered at a hearing held by a committee of the present Legislature, but was stopped on Mr. Carter's objection to the competency of such proceedings as evidence. Justice Ingraham remarked that, judging from the experience of the past year, evidence taken before legislative committees sitting here and in the state is of little value.

Mr. Eggleston in opposition read affidavits showing that the price cannot be less than $240 a year without limiting the quantity and lowering the quality of the service furnished.

Bonham, Tex.—The Bonham Telephone company has been formed; capital stock, $4,000. Incorporators, H. C. Alexander, Ben Dabney and M. H. Johnson.

TELEPHONE ACTIVITY IN OHIO.

A movement is on foot in Ohio to establish several long distance telephone lines between all the larger cities of the State. A meeting has been held at Columbus, at which a permanent organization was formed, a constitution adopted and the following officers elected: President, Judge J. M. Thomas; vice-presidents, Charles Parrott, Jason Blackford, and H. D. Critchfield; secretary, James K. Hamill; assistant secretary, Caleb L. McKee; treasurer, Newton Leggitt; executive committee, George W. Sinks, F. L. Beam, H. H. Weller, Jerome Penn, C. H. Lewis, and L. P. Lewis. The places represented in the organization are Columbus, Chillicothe, Mount Vernon, Newark, Bucyrus, Lima, Akron, Vanwert, St. Mary's, Zanesville, Cambridge, Delaware, and Troy. The combination expects to establish lines in opposition to the Bell Company.

INTERNATIONAL BELL COMPANY REDUCES ITS CAPITAL.

The International Bell Telephone Company, Limited, of New York City, has filed with the Secretary of State a certificate of the reduction of its capital stock from $1,700,000 to $1,000,000. The certificate is signed by Samuel D. Babcock, Gardiner G. Hubbard, William Mertens, Richard A. McCurdy, Charlton T. Lewis, and Howard S. Randall, directors of the company. Of the stock to be cancelled $402,800 was held in the treasury of the company. The debts and liabilities of the corporation do not exceed $200,000.

TELEPHONE NOTES.

CLINTON, IA.—The Tri-City Telephone Co. is beginning the construction of its lines in Clinton, Lyons and Fulton.

FOND DU LAC, WIS.—Frank H. Sweet and Waldo Sweet are securing subscriptions for a new local telephone exchange.

NEW BRITAIN, CONN.—At a meeting of the new telephone company R. C. Wooster was elected president; R. Schrey, secretary; R. L. Andrews, treasurer.

TEXARKANA, TEX.—Mr. J. W. Davis, W. A. Williams and others have secured a franchise for a new telephone exchange in this city.

ALICE, TEX.—W. B. Mullen is at Alice in the interest of the Alice, Wade's City & Corpus Christi Telephone Co. The line will be extended to the big ranches of Texas.

BROOKVILLE, IND.—The American Telephone Construction company has been granted a franchise to put in and operate an exchange at Brookville.

UTICA, N. Y.—The Central New York Telephone and Telegraph Company has accepted the franchise granted by the Common Council for subways.

BEATRICE, NEB.—A co-operative telephone exchange is being organized here in opposition to the old telephone company. A. M. Craig is the principal man in the enterprise.

ROCHESTER, MINN.—A franchise has been granted to Fred S. Haines and J. A. Melone for the construction of a telephone exchange in Rochester, the system to be inaugurated within six months.

CORDELE, GA.—The Cordele Telephone Co. is advertising for a charter. It is to have a capital stock of $10,000, and will operate a telephone system in Cordele and put in lines to surrounding towns.

HAVERHILL, MASS.—The People's Telephone company has been organized in this city with a paid in capital of $1,000. Edward H. Hoyt is president, Philip C. Sweet, treasurer, and Ira O. Sawyer clerk of the company.

ASBURY PARK, N. J.—The Mutual Telephone Company has completed its organization. Washington White was elected president; John Forman, vice-president; A. O. S. Havens, treasurer, and W. J. Lansley secretary.

CIRCLEVILLE, O.—At a regular meeting of the city council H. H. Myers of Columbus was granted a franchise to place an electric telephone system in the city. Work will be commenced at once.

SHENANDOAH, PA.—Hon. B. J. Monaghan has asked for a right of way through the streets and alleys of town for the Schuylkill Telephone Company, which proposes doing a general telephone business throughout the region, from Shamokin to Mahanoy City, and from Mahanoy City to Pottsville.

NEW YORK STATE.—The Phoenix Telephone Company of New York has purchased of Wm. Lieb of Jeffersonville, John H. Kilbourne and C. A. Sprague, the telegraph lines between Liberty, Jeffersonville and White Lake, which it will promptly convert into telephone lines.

LA CROSSE, WIS.—The La Crosse Telephone Company have again begun active operations. It is probable that before many weeks the work of constructing their new plant will be begun.

WILMINGTON, VT.—Mr. Crosier is putting in a telephone connecting Mountain Mills with Wilmington village and Whitingham.

SUNBURY, PA.—The Anthracite Telephone and Supply Company has received its telephones and the work of putting up the line will be commenced as soon as possible.

EAU CLAIRE, WIS.—F. M. Miner who is backed by New York capital, has asked the council of this city to put in a telephone service between Belvidere, Eau Claire, Chippewa Falls and Menominee.

RAVENNA, O.—The Portage Telephone Company, of Ravenna, has been incorporated with a capital stock of $25,000. W. H. Butler, W. G. Robinson, Harvey Musser, L. K. Mihils and Nathan Morse are the incorporators.

SANTA CRUZ, CAL.—The Popular Telephone Company has been organized. Principal place of business, Santa Cruz. Capital stock, $25,000; with C. A. Rice, W. H. Lamb, W. E. Peck, Joseph Schwartz and F. W. Swanton of Santa Cruz as directors.

CLARKSBURG, W. VA.—The telephone line has been completed from Wallace to this city. The route is by way of Adamston, Wilsonburg, Reynoldsville, Sardis and Oral, and opens up communication with a large part of this and Doddridge County.

TAYLOR PLACE, MO.—The Dryden & Spratt Telephone Company of Taylor Place has been formed; capital stock, $500,000. Incorporators: John Dryden, J. A. Spratt, Wm. R. Taylor and others.

CHATEAUGAY, N. Y.—C. W. Sprague has asked the Chateaugay village board for a franchise to maintain a local telephone line, the instruments for which are his own invention. Mr. Sprague stated that his telephones would be rented for $2 a month.

OSHKOSH, WIS.—The Oshkosh Northwestern Telephone Company has elected the following officers: President, W. H. Hay; treasurer, Charles Schriber; directors, E. E. Stevens, Tom. Rockwell, W. H. Hay, Charles Schriber and F. L. Humes.

HAVERSTRAW, N. Y.—The Hudson River Telephone Company have rebuilt their exchange at Haverstraw and put their lines there in first-class shape. All new wires have been put on the poles and the line will be extended.

OMAHA, NEB.—Casper E. Yost, president of the Nebraska Telephone Co. has announced that telephone rates would, hereafter, be reduced about 25 per cent. in all Nebraska points. The rate within certain limits is to be $48 instead of $60.

STAUNTON, VA.—The Staunton Mutual Telephone Company has been chartered. The officers are R. S. Turk, president; W. L. Oliver, vice-president; Edgar M. Funkhouser, secretary and treasurer, together with William Patrick, W. W. McGuffin and H. A. Shepherd, directors.

PORTLAND, ME.—The Maine Telephone Company has elected these officers: President, Fred Atwood of Winterport; treasurer, Edward Swazey of Bucksport; secretary, T. W. Vose of Bangor; directors, T. W. Vose, George Wescott of Portland, and Fred Atwood.

WATERTOWN, N. Y.—Two years or more ago the Shaver Telephone company, of New York, secured from the common council a franchise in Watertown. They never utilized the franchise, however, and recently A. L. McCrea, of Gouverneur, purchased it. He now intends to put a plant in operation.

SYCAMORE, ILL.—Application has been made to the Secretary of State for articles of incorporation of the DeKalb County Telephone Co. The incorporators, who represent the 40 stockholders, are C. E. Walker, W. H. Rogers, F. O. Van Gelder, Elthom Rogers, Walter Langlois.

WINNSBORO, S. D.—A charter has been issued to the Winnsboro-Ridgeway Telephone Co., which will operate a telephone line between Winnsboro and Ridgeway. W. R. Rabb is president; J. Q. Davis, secretary and treasurer, and E. C. Heins, superintendent.

MOBILE, ALA.—At a meeting of the projectors of the Home Telephone Company, the capital stock of the company was fixed at $40,000, and the entire amount was subscribed at the meeting. Messrs. James K. Glennon, A. S. Lyons, P. J. Lyons, D. R. Burgess, A. H. Spira, W. H. Fitzpatrick, Henry Piser, Adam Glass and A. S. Benn were elected directors.

MARION, S. C.—A commission for a charter has been issued to the Pee Dee Telephone Company. The company proposes to build a telephone line in Marion county, and to connect Marion, Latta and Dillon. The capital stock of the company will be $800 and the incorporators named are: D. H. David, D. M. Due and J. M. Johnson.

REPORTS OF COMPANIES.

ANNUAL MEETING OF THE GENERAL ELECTRIC CO.

The annual meeting of the stockholders of the General Electric Company was held on May 14 at Schenectady. Ten thousand more shares of stock were represented than at last year's meeting. No action was taken nor was any proposition or report made relative to a reduction of the capital stock. This Board of Directors for the following year was elected: Oliver Ames, second, T. Jefferson Coolidge, Jr., C. H. Coster, Thomas A. Edison, Eugene Griffin, Gordon Abbott, F. S. Hastings, Henry L. Higginson, George F. Gardner, J. Pierpont Morgan, Robert Treat Paine, second, Thomas J. Cummins, Jr. and C. A. Coffin.

H. McK. Twombly and D. O. Mills retired from the board. Their places are filled by George F. Gardner and Thomas J. Cummins, Jr. Mr. Gardner is a member of a well-known Boston family, and is a trustee of many large estates. Mr. Cummins is a member of the Boston bar. He is a Harvard graduate, class of '84. Mr. Cummins consented to serve temporarily, owing to the fact that only short notice had been given by Messrs. Mills and Twombly of their determination not to serve as Directors another year. Officers for the ensuing year are to be elected by the new Board of Directors. It is rumored that First Vice President Griffin is to retire to manage a business concern at New York. It is not known that any other important change in the list of officers is in prospect.

The annual report of President Coffin, with supplementary report of Mr. Ord, has already been published in THE ELECTRICAL ENGINEER. A list of the subsidiary holdings of the company is now added :—

(SCHEDULE A.)

Stocks.

CORPORATE NAME.	ADDRESS.	PAR VALUE.
LOCAL COMPANIES.		
Alamo Electric St. Railway Co	Alamo, Texas	$40,000.00
Amsterdam Street Railway Co	Amsterdam, N. Y	9,900.00
Andover Electric Co	Andover, Mass	2 000 00
Appleton Edison Electric Co	Appleton, Wis	15,000.00
Athol Gas and Electric Co	Athol, Mass	600.00
Austin Electric Co	Austin, Minn	50,000.00
Barberton Electric Co	Barberton, O	39,250.00
Bay Shore Electric Light Co., L't'd.	Bay Shore, N. Y	1,000.00
Bethlehem Elec. Light Co	Bethlehem, Pa	675 00
Bridgeton Elec. Light Co	Bridgeton, N. J	25,000.00
Buffalo General Electric Co	Buffalo, N. Y	260,000.00
Cambridge Electric Light Co	Cambridgeport, Mass.	2,700 00
Camden Power & Light Co	Camden, Ark	10,000.00
Canton Electric Light and Power Co	Canton, O	12,200 00
Chatham Electric Light Co	Chatham, N. Y	1,100.00
Charlotte Electric Light Co	Charlotte, N. C	1,500 00
Charleston Light and Power Co	Charleston, S. C	94,175.00
Chester Electric Light and Power Co	Chester, Pa	3,000 00
Chicago Edison Co	Chicago, Ill	183,600.00
Cincinnati Edison Electric Co	Cincinnati, O	383,300 00
Citizens General Electric Co. (Com.)	Louisville, Ky	264,400.00
Citizens General Electric Co. (Pref.)	Louisville, Ky	67,900 00
City Electric St. Railway Co	Little Rock, Ark	20 000 00
Cleveland El. Ilg. Co. (Com)	Cleveland, O	112,000 00
" " " (Pref.)	"	59,400.00
Com. Anonima del Alumb El de Puebla	Puebla, Mexico	15,000 00
Consumers' Light & Power Co	Little Rock, Ark	25,000.00
Consolidated Electric Light Co	Birmingham, Ala	414,511.68
Cooperstown Gas and Electric Co	Cooperstown, N. Y	2 250 00
Columbus Ed. Electric Light Co	Columbus, O	23,100 00
Crown Point Electric Co	Crown Point, Ind	10,000.00
Davenport Power and Light Co	Davenport, Ia	50,000.00
Des Moines Edison Light Co	Des Moines, Ia	93,720.00
Dillon General Electric Co	Dillon, Montana	40,000.00
Dubuque Light & Traction Co	Dubuque, Ia	5,000.00
Eastchester Electric Co	Mount Vernon, N. Y	82,645.00
Edison Illuminating Co	Easton, Pa	4,250 00
Edison Electric Light Co	Philadelphia, Pa	23,022.00
Edison Electric Illuminating Co	Paterson, N. J	31,500 00
" " " "	New York, N. Y	200,200.00
" " " "	Cumberland, Md	8,500.00
" " " "	Newburgh, N. Y	29,650 00
" " " "	St Louis, Mo	40,000.00
" " " "	Altoona, Pa	10,000 00
Edison Electric Light and Power Co	Kansas City, Mo	14,200.00
" " " " " "	York, Pa	13,200.00
" " " " " "	Erie, Pa	14,400.00
Edison Electric Illuminating Co	New Brunswick, N. J	9,500.00
Elgin City Railway Co	Elgin, Ill	40,000 00
Essex County Electric Co	Orange, N. J	5,000.00
Fairhaven & New Whatcom Ry. Co.	Fairhaven, Wash	50,000 00
Fargo Gas & Electric Co	Fargo, No Dakota	20,000 00
First Cincinnati Edison El. Ilg. Co	Cincinnati, O	8,700.00
Fort Clark Street Railway Co	Peoria, Ill	177,750.00
Framingham Gas, Fuel and Power Co	Framingham, Mass	500 00
Geneva Brush Electric Lt. and P. Co	Geneva, N. Y	10,000.00
Glens Falls Electric Light & P. Co., Ltd	Glens Falls, N. Y	550.00
Goshen Light and Power Co	Goshen, N. Y	100 00
Grand Rapids Edison Lt. & Fuel Gas Co	Grand Rapids, Mich.	29,000.00
Grinnell Electric Light Co	Grinnell, Iowa	1,000 00
Hackensack Edison Lighting Co	Hackensack, N. J	59,500 00
Hollister Light and Power Co	Hollister, Cal	250.00
Hudson Electric Light Co.	Hoboken, N. J	275,000.00
Huntsville Electric Light Co	Huntsville, Ala	2,300 00
Jacksonville Electric Light Co	Jacksonville, Fla	100.00
Jackson Lt. & Power Co	Jackson, Mich	25,000.00

SCHEDULE A.—*Continued.*

Stocks.

CORPORATE NAME.	ADDRESS.	PAR VALUE.
LOCAL COMPANIES		
Johnstown Electric Light Co	Johnstown, Pa	$18,900.00
Kingston Electric Co	Kingston, N. Y	43,650.00
La Compagnie Electrique de Valleyfield	Valleyfield, P. Q	1,000 00
Laramie E. G. L. & F. Co	Laramie, Wy	16,500.00
Little Falls Electric Light and P. Co	Little Falls, N. Y	2,500.00
Los Angeles Edison Electric Co	Los Angeles, Cal	40,000.00
Macon Consolidated St. R. R. Co	Macon, Ga	490,000.00
Maryland Electric Co	Baltimore, Md	500.00
Metropolitan St. Railway Co	Macon, Ga	100 000.00
Millbury Electric Co	Millbury, Mass	2,000.00
Napa Thomson-Houston Light Co	Napa, Cal	33,500.00
Narragansett Pier E. L. & P. Co	Narrag'st Pier, R. I	40,000.00
Natick Electric Co	Natick, Mass	37,500 00
Natick Gas Light Co	Natick, Mass	10.100 00
New Omaha T-H. El. Light Co. (Com.)	Omaha, Neb	30,600 00
Newport Illuminating Co	Newport, R. I	36,700.00
Northwest Electric Co., L'd	Winnipeg, Man	20,000.00
Oshkosh Electric Light and Power Co	Oshkosh, Wis	2,300 00
Ottawa Electric St. Railway Co.	Ottawa, Ill	68,000.00
Overland Railway Co	Nashville, Tenn	5,000 00
Oxford Lake Line (Pref.)	Anniston, Ala	36 013 50
Portland General Electric Co. (Com.)	Portland, Ore	527,800 00
Pueblo City Railway Co	Pueblo, Col	50 000 00
Queen City Railway Co	Dallas, Texas	200,000.00
Queen City Electric Railway Co	Marion, Ind.	50,000 00
Raleigh Electric Co	Raleigh, N. C	3,000.00
Rensselaer Water, Light and Power Co.	Rensselaer, Ind	30,000.00
Roseberg E. L. & P. Co.	Roseberg, Ore	20,000.00
Roanoke E. L. & P. Co	Roanoke, Va	5,000 00
Rome Gas Light Co	Rome, Ga	17,500 00
Rutland Electric Light Co	Rutland, Vt	15,000 00
Scranton Illuminating, Heat and P. Co	Scranton, Pa	42,000 00
Seneca Electric Co	Seneca, N. Y.	300 00
Skowhegan Electric Light Co	Skowhegan, Me	4.300.00
Standard Light and Power Mfg. Co	Montpelier, Vt.	1,000.00
Syracuse Consolidated Street R'y Co.	Syracuse, N. Y	20,500 00
Tacoma Railway & Motor Co	Tacoma, Wash	45,000.00
Thomson-Houston Electric Co	Augusta, Ga	3 000 00
Thomson-Houston El. Light and P. Co.	Quincy, Ill	2,200.00
Toledo Electric Co	Toledo, O.	600 00
Trenton Light and Power Co	Trenton, N. J	62,500 00
Twin City General Electric Co	Ironwood, Mich.	100,000 00
Union Street Railway Co	Dover, N. H	8,800.00
Utica Belt Line St. R. R. Co. (Pref.)	Utica, N. Y.	50,000.00
Vancouver Electric Ry. and Light Co	Vancouver, B. C	3,100 00
Visalia Gas Light and Heat Co	Visalia, Cal	14,700 00
West Asheville Improvement Co. (Pref.)	Asheville, N. C	80,000.00
Westboro Electric Light and Power Co	Westboro, Mass	1,620 00
West Asheville Improvement Co. (Com.)	Asheville, N. C	80,000 00
Weymouth Light and Power Co	Weymouth, Mass	5,000.00
Wilkesbarre Electric Light Co	Wilkesbarre, Pa	10.100.00
MANUFACTURING CO'S.		
Brush Electric Co. (Pref.)	Cleveland, O	122,800.00
" " " (Com.)	" "	1,995,200.00
Canadian General Electric Co., Ltd	Toronto, Can	1,250,000.00
Excelsior Electric Co	New York City	387,000.00
Fort Wayne Electric Co	Fort Wayne, Ind	2,000,450 00
Ft. Wayne Trust Securities. (Series A)	Boston, Mass	9.776 00
Otis Electric Co	Yonkers, N. Y	174,000.00
Schuyler Electric Co	Middletown, Ct	50,000 00
Schuyler Electric Mfg. Co. (Com.)	Hartford, Ct	84,000 00
Schuyler Elec. Mfg. Co. (Pref.)	Hartford, Conn	307 930 00
Short Electric Railway Co	Cleveland, O	2,000,000 00
Spanish-American Light & P. Co	Jersey City, N. J.	4,000.00
Swan Lamp Mfg. Co	Cleveland, Ohio	33,000 00
Union Elektricitäts Gesellschaft	Berlin, Germany	50,026 00
United Electric Securities Co. (Com.)	Boston, Mass	500,000 00
" " " " (Pref.)	" "	23,100.00
Total		**$14,902,164 13**

(SCHEDULE B.)

Bonds.

CORPORATE NAME.	ADDRESS.	PAR VALUE.
Arkadelphia Water and Light Co.	Arkadelphia, Ark	$9,000.00
Atlanta Consolidated Street Railway Co	Atlanta, Ga	18,000.00
Barberton Electric Co.	Barberton, O.	20,000.00
Bangor Electric Light and Power Co.	Bangor, Me	64.500.00
Binghamton General Electric Co	Binghamton, N. Y	2,000 00
Brooklyn Heights R. R. Co. & L. I. Tr. Co.	Brooklyn, N. Y	194,000.00
Camden Power & Light Co	Camden, Ark.	10,000.00
Camden Lighting and Heating Co	Camden, N. J	30,500 00
Central Vermillion Iron Co	St. Paul, Minn	3,500.00
Charleston Light and Power Co	Charleston, S. C.	25,000.00
Chattanooga Electric Ry. Co.	Chattanooga, Tenn	20,000.00
Cicero Light, Heat and Power Co.	Cicero, Ill	700.00
Cincinnati Edison Electric Co	Cincinnati, O.	225,000.00
Citizens General Electric Co	Louisville, Ky	70,000 00
City Electric Street R'y Co.	Little Rock, Ark	100,000.00
Concord Land & W. P. Co	Concord, N. H	119,500.00
Congaree Gas & Electric Co	Columbia, S. C	500 00
Consolidated Electric Light Co	Birmingham, Ala	79,000.00
Consumers Light and Power Co	Little Rock, Ark	27,000.00
Crescent City R. R. Co	New Orleans, La	129,000.00
Crown Point Electric Co.	Crown Point, Ind	10,000.00
Cumberland Electric Light and Power Co.	Nashville, Tenn	60,000.00
Dallas Electric Co	Dallas, Tex	1,000.00
Dayton Electric Light Co	Dayton, Ohio	297,000.00

SCHEDULE B.—*Continued.*

Bonds.

CORPORATE NAME.	ADDRESS.	PAR VALUE.
Decatur Light, Ill'g & F. Co.	Decatur, Ala.	$3 750.00
Dedham Electric Co.	Dedham, Mass.	47,000 00
Dubuque Light & Traction Co.	Dubuque, Iowa	7,000.00
East Chester Electric Co.	Mt. Vernon, N. Y.	39,000.00
Fort Wayne Electric Corporation	Fort Wayne, Ind.	325,000.00
Gallitzen Electric Light Co.	Gallitzen, Pa.	7,000.00
Greensboro Electric Light & Power Co.	Greensboro, N. C.	2,500.00
Hoosac Valley St. Railway Co.	North Adams, Mass.	800.00
Jackson Light and Power Co.	Jackon, Mich.	83,000 00
Kansas City, Pittsburg & Gulf R. R. Co.	Kansas City, Mo.	3,500 00
Kingston Electric Co.	Kingston, N. Y.	7,000.00
Knoxville Electric Light and Power Co.	Knoxville, Tenn.	10,000.00
Knoxville Street Railroad Co.	Knoxville, Tenn.	6,000.00
Lee Electric Co.	Lee, Mass.	11,000 00
Los Angeles Cons. Electric Ry. Co.	Los Angeles, Cal.	41,440.00
Macon Consolidated Street Railway Co.	Macon, Ga.	300,000 00
Metropolitan Street Railway Co.	Macon, Ga.	45,000.00
Millbury Electric Co.	Millbury, Mass.	16,000 00
Madison City Railway Co.	Madison, Wis.	22,000.00
Manhattan Electric Light Co.	New York City	48,000.00
Milwaukee Street Railway Co.	Milwaukee, Wis.	325,000 00
Narragansett Pier El. Light and P. Co.	N'gansett Pier, R. I.	1,000 00
Natick Electric Co.	Natick, Mass.	17.500 00
North River Electric Light and P. Co.	New York	2,000.00
Ocala Light and Power Co.	Ocala, Fla.	10 000.00
Oskaloosa Edison Light Co.	Oskaloosa, Wis.	7,500 00
Oshkosh Electric Light and Power Co.	Oshkosh, Wis.	5 650.00
Otis Electric Co.	Yonkers, N. Y.	20,000.00
Ottawa Street Railway Co.	Ottawa, Ills.	51,000.00
Overland Railway Co.	Nashville, Tenn	11,500.00
Oxford Lake Line	Anniston, Ala.	175,000.00
Peoples Electric Light and Power Co.	Oswego, N. Y.	84,000 00
Petersburg Street Railway Co.	Petersburg, Va.	25,000 00
Piedmont Chautauqua Co.	Atlanta, Ga.	1,000.00
Piedmont Exposition Co.	Atlanta, Ga.	2,000.00
Plymouth Electric Light Co.	Plymouth, Mass.	01,000.00
Portland General Electric Co.	Portland, Ore.	67,000.00
Public Works Co.	Bangor, Me.	35,000 00
Pueblo City Railway Co.	Pueblo, Col.	50,000.00
Queen City Electric Railway Co.	Marion, Ind	5,000 00
Queen City Railway Co.	Dallas, Tex.	85,000.00
Rainier Power & Railway Co.	Seattle, Wash.	21.000 00
Rensselaer Water, Light and Power Co.	Rensselaer, Ind.	20,000 00
Rochester Railway Co.	Rochester, N. Y.	35,000 00
Sacramento Elec. Power & Light Co.	Sacramento. Cal.	10,000 00
San Francisco & San Mateo Ry. Co.	San Mateo, Cal.	15,000.00
Sea Shore Electric Railway Co.	Asbury Park, N. J.	6,000 00
Standard Plate Glass Co.	Pittsburg, Pa.	1 600.00
Steubenville Street Railway Co.	Steubenville, O.	2 500.00
St. Cloud City Street Car Co.	St. Cloud, Minn.	5,000.00
Tacoma Railway and Motor Co.	Tacoma, Wash.	200,000.00
Trumbull Electric Railway Co.	Warren and Niles, O.	74,000.00
Toledo Electric Co.	Toledo, O.	6,000 00
Town of Buena Vista	Buena Vista, Va.	1,600.00
United Electric Sec. Co.	Boston, Mass.	220,000 00
Watertown Heating, Lighting & P. Co.	Watertown, S. Dak.	2,000 00
West Asheville Improvement Co.	Asheville, N. C.	100,000 00
West Street & North End Elec. Ry. Co.	Seattle, Wash.	4,000 00
Weymouth Light and Power Co.	Weymouth, Mass.	34,000 00
Winona General Electric Co.	Winona, Minn.	20,000 00
Total		$4,354,040.00

THE HARRISON INTERNATIONAL TELEPHONE COMPANY.

Stockholders of the Harrison International Telephone Company met in Chicago recently and re-elected the following directors: Stephen B. Elkins, R. C. Kerens, George R. Peck, William Warner, C. M. Ferree, Dr. E. M. Harrison, and H. M. Holden, Kansas City; H. J. Hanford and Patrick Egan, New York. Mr. Robert P. Porter, Cleveland, was succeeded in the Directory by H. S. Smith, consulting engineer of the Illinois Steel Company. J. T. Blake, a capitalist of Kansas City, was added to the list. The company's telephones are in operation in more than 150 places, and construction companies are organized in thirty-one States. General Manager Hanford says there will be war to the end with the rival companies who have referred to the Harrison Company as a "paper concern." He also says the company cannot be bought.

LEGAL NOTES.

AN IMPORTANT NEW YORK DECISION AS TO SUBWAY TOLLS AND RIGHTS.

The claims of the Empire City Subway Company of New York to the power of levying toll on all underground electric wires has been negatived by a decision handed down by the General Term of the Supreme Court. When the Broadway and Seventh Avenue Railroad Company and the Columbus and Ninth Avenue Railroad Company arranged some time ago to run electric signal wires through their cable trenches, the Empire Company came forward with a claim that any such wire would have to pass through its subways and submit to the tolls for rental. The Broadway officers declined to admit any such monopoly, and the Subway Company applied for an injunction in Supreme Court Chambers. The application was denied, and the decision handed down was on the Subway Company's appeal.

Judge Follett, who writes the opinion of the court, says that, even conceding that the railroad companies have violated the subway statutes, and that the Commissioners of Electrical Control could maintain an action against them, it would not constitute a cause of action against them by the Empire City Subway Company unless some right of property of that company had been injured. The Judge says that it does not appear that the Subway Company has any exclusive franchise, and, apart from the question of authority, the Commissioners did not grant or intend to grant the company any exclusive right to construct and operate subways, while these railroad companies were empowered to "use a system of signals to the central house to stop the engines in case of accident," and for that purpose they were not bound to use the conduits of the Subway Company. "If," says Judge Follett, "the construction of the subway statutes contended for by the plaintiff is to prevail, it would be impossible for a surface road to be operated on many of the streets by electricity, as authorized by Chapter 531 of the Laws of 1889, unless its conductors were placed in the plaintiff's subways."

INJUNCTION AS TO THE COWLES ALUMINUM PROCESS.

In the U. S. Circuit Court at Cleveland, Judge Taft has handed down his decision in the suit by Francis Lowrey, executor of the estate of Grosvenor P. Lowrey, against the Cowles Electric Smelting & Aluminum Company and Alanson T. Osborn for infringement of patent sold and assigned to plaintiff by Charles S. Bradley for a process of separating metals, particularly aluminum, from their ores by the use of an electric current, etc., the Judge holding that the defendants had infringed. He granted the plaintiffs a perpetual injunction, restraining the defendants from using the patent rights and ordered the letters of patent held by the Cowles people canceled and declared void.

THE EDISON LAMP SOCKET PATENT SUSTAINED.—EDISON ELEC. LT. CO. vs. BRYANT ELEC. CO.

ON Monday, May 13, Judge Shipman, at Hartford, Conn., granted an injunction against the Bryant Electric Company in favor of the Edison Electric Light Company on the second claim of the patent granted to Sigmund Bergmann May 2, 1882, No. 257,274, covering the Edison style of socket. The claim of the Bergmann patent is as follows:

"In an electric socket, the combination with the body of insulating material, of a plate in the bottom of the socket, and a horizontal screw-ring located between the bottom plate and the mouth of the socket, said plate and ring engaging opposite parts on an entering base or plug and serving to compress the base or plug between the terminals carried by it, substantially as set forth."

This patent was first sustained by Judge Coxe, at Utica, N.Y., March 21, 1894, as the result of a protracted litigation against the Electric Engineering and Supply Company of Syracuse, N. Y., and on February 14, 1895, the U. S. Circuit Court of Appeals for the Second Circuit (Judges Wallace, Lacombe and Shipman sitting) affirmed Judge Coxe's decision. The litigation has been conducted for the Edison Co. by Mr. Richard N. Dyer, of the firm of Dyer & Driscoll. Messrs. Howson & Howson appeared for the defense.

A DECISION RESTORING VALIDITY TO THE BERLINER PATENT.

At Boston, on May 18, the United States Circuit Court of Appeals reversed the decree of Justice Carpenter declaring invalid the Berliner telephone patent. Justices Colt, Putnam and Nelson, sitting in the case, which was that of the American Bell Telephone Company et. al., appellant vs. United States of America, appellee, at 12.30 o'clock sent down this order:

"The decision of the Circuit Court is reversed and the case is remanded to that Court, with directions to dismiss the bill. It is ordered that the appellee have leave to file their motion as to the form of judgement now on the clerk's list and also a brief in support of the same on or before the 25th inst. The appellants to file brief in reply on or before the 31st. inst."

The opinion giving the reasons for the decision has not yet been written out. Judge Carpenter, on Dec. 18, 1894, decided that the Berliner patent was invalid and ordered it to be delivered up for cancellation. The company appealed. The Berliner patent is No. 463,569, and was issued on Nov. 17, 1891 to Emile Berliner. Editorial comment on the situation will be found on page 475 of this week's issue of THE ELECTRICAL ENGINEER.

MR. L. A. FERGUSON, electrical engineer of the Chicago Edison Co., has been in the East the past week attending to several important technical matters for that progressive local company.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 14, 1895.

Alarms and Signals:—

Railway Signal System, G. L. Thomas, Brooklyn, N. Y., 539,154. Filed Jan. 28, 1895.

Electric Fire and Water Alarm, G. S. Neu, New York, 539,234. Filed Jan. 25, 1895.

Has for its object to produce an alarm which indicates electrically the start of a fire and reports also the start of the automatic sprinkler or any possible occuring leak or deficiency in the same when only a small quantity of water will run out.

Signaling System, J. P. Coleman, Swissvale, Pa., 539,351. Filed Aug. 26, 1893.

A railroad signaling system intended to insure the locking of the signal at the end of a block station at normal or danger before the signal at the entrance to the section can be cleared.

Communicating Signaling, etc., to or from Movable Objects, J. Y. Porter, Cleveland, Ohio, 539,298. Filed Feb. 14, 1894.

A trolley or current supply wire, parallel conductors and insulated supports therefor, pivoted connections between such supports and the conductors, and a current collector engaging the trolley wire; the said conductor being free to move across the path of travel of the collector.

Railway Signal, J. Stringham, Jersey City, N. J., 539,396. Filed Feb. 6, 1895.

Conductors, Conduits and Insulators:—

Insulator, L. H. Desisles, Boston, Mass., 539,040. Filed Sept. 10, 1894.

A cleat so designed that every length of wire between any two cleats is independent of the other.

Dynamos and Motors:—

Carbon Brush Holder for Dynamos, W. S. Bosley, Chicago, Ill., 539,032. Filed Sept. 8, 1894.

Details of construction.

Electric Motor, J. C. Lincoln, Rochester, N. Y., 539,277. Filed Jan. 16, 1892.

Claim 1.—The combination with the shunt field magnet connected in series across the main line, of the armature, the series coil partially surrounding the armature and directly magnetizing it, said coil and armature being connected in series with each other across the main line.

Starting Box for Electric Motors, D. M. Bliss, Boston, Mass., 539,376. Filed Feb. 20, 1895.

The switch is maintained in its "on" position by an electro-magnet so that on the rupture of the current the switch is automatically thrown off.

Controller for Electric Motors, H. F. Parshall & J. W. Darley, Jr., Lynn, Mass., 539,293. Filed Feb. 11, 1893.

The combination with a controller cylinder for an electric motor, for an electric motor for actuating said cylinder, and means for returning the cylinder to its normal position when the line current is broken.

Lamps and Appurtenances:—

Electric Lamp, W. H. Sheppard, New York, 539,150. Filed Nov. 20, 1894.

An incandescent light socket having bracket arms secured thereto, which bracket arms may or may not swing and have secured at their lower end a shade and support for an electric lamp, the wires being led through one of the brackets.

Electric Light Head Gear for Personal Wear, A. M. Rodrigues, Brooklyn, N. Y., and E. D. Rockwell, Bristol, Conn., 539,192. Filed Feb. 25, 1895.

Relates to an improved cap, particularly designed for the use of bicyclists.

Electric Arc Lamp Clutch, W. B. Luce, Brookline, Mass., 539,365. Filed Mch. 15, 1894.

Involves an improved clutch.

Arc Lamp, C. A. Pfluger, Chicago, Ill., 539,392. Filed Apl. 5, 1894.

Two electrodes having each two carbons at an acute angle with each other.

Electric Arc Lamp, C. A. Pfluger, Chicago, Ill., 539,393. Filed July 2, 1894.

Details relating to a lamp employing curved carbons.

Miscellaneous:—

Electric Push Button, A. J. Oehring, Chicago, Ill., 539,079. Filed Nov. 2, 1893.

Details of construction.

Variable Rheostat, E. P. Warner, Chicago, Ill., 539,105. Filed Sept. 18, 1894.

A contact device is adapted to travel over the wires, provided with contact rollers which are adapted to bear upon a number of the convolutions of the winding at the same time.

Rheostat, A. C. Carey, Lake Pleasant, Mass., 539,216. Filed Feb. 26, 1895.

The spool has a body of metal and an insulating barrel and heads of mica, or other refractory and insulating material, and the wire is wound thereon in layers insulated from each other.

Railways and Appurtenances:—

Electrical Connector, F. N. Bell, Milford, Mass., 539,024. Filed July 28, 1894.

Consists of a rail bond embodying a thimble and cone which are pressed into contact with the web of the rail by a nut.

Closed Conduit Electric Railway, P. Lucas, Berlin, Germany, 539,184. Filed June 23, 1894.

The contacts with the enclosed conductor are made through the medium of a rocking arm.

Electric Conductor, J. R. Hare, Baltimore, Md., 539,232. Filed Nov. 23, 1894.

Consists in providing the portion of the conductor which does not come in contact with the trolley wheel, with a coating of some vitreous substance.

Telegraphs:—

Means for Effecting Synchronism, J. H. Rogers, Washington, D. C., 539,369. Filed Dec. 29, 1888.

Improvements on same inventor's system of synchronous telegraphy.

Telephones:—

Telephone, M. Martin, Malden, Mass., 539,068. Filed Nov. 10, 1886.

The combination of the magnet having a pole piece terminating in a laterally projecting flange or edge with a diaphragm composed of magnetic material having a portion of said magnetic material removed opposite the end of the magnet-pole.

Telephone Transmitter, R. F. Rice, Hartford, Conn., 539,086. Filed May 18, 1893.

In a telephone transmitter, the combination with the diaphragm of an undulator consisting of a multiplicity of surface contacting members under successively increased loads, and comprising single-part and multi-part members in alternate succession.

Annunciator Connection for Multiple Switchboards, G. Taintor, Keene, N. H., 539,099. Filed April 11, 1892.

The combination with a telephone circuit, of an annunciator included in series in said circuit, a normally open short circuit about said annunciator and means for closing said short circuit by the act of making connection with the line.

Telephone Circuit and Apparatus, C. W. McDaniel, Kansas City, Mo., 536,142. Filed Mch. 16, 1895.

An arrangement whereby a substation at either end of the circuit may be in conversational connection with the central office nearest thereto, and whereby two way stations centrally located in the circuit may at the same time be conversing with each other.

Telephone Transmitter, A. C. Brown, London, Eng., 539,163. Filed Sept. 27, 1894.

An electrode in the form of the frustum of a cone with an elastic packing forming a ring around said electrode, and a mass of granules filling the triangular space between the cone, the ring, and the diaphragm, and subjected by said ring to an elastic pressure exerting a constant tendency to cause the granules to move up the incline of the cone.

Magneto Call Apparatus, F. B. Cook, Chicago, Ill., 539,170. Filed Dec. 26, 1894.

An arrangement such that a current cannot be sent from the generator until the telephone has been removed from the hook switch. Intended for party lines.

Mounting for Telephones, T. Kelly, Philadelphia, Pa., 539,274. Filed Sept. 8, 1894.

The transmitter and receiver and the call box are mounted upon a slab of stone supported some distance from the wall of the room.

FINANCIAL.

GROWING FIRMNESS OF THE STOCK MARKET.

THE course of finance during the past week was not eventful, the expected "reaction" from the previous enthusiasm taking place with due regularity. But the undercurrent of hopefulness was strong, general conditions of trade and manufacture showed improvement, and the railroads exhibited a growing traffic. The gain in value of 100 stocks from their starting point at the beginning of the year is nearly $300,000,000, or a general rise of 10 per cent., and the greatest advances are in "industrials."

As might be expected, the Boston market closed strong on Saturday as to Bell Telephone, after the reversal in favor of the Berliner decision, and the closing price was around 198; but it still remains to be seen if the patent has any virtue left in it. In New York, General Electric has hovered around 34 through the week; and Western Union closed at 92¾. Commercial Cable exhibits strength at 150, with few dealings. There were no changes in Boston worth mentioning in Westinghouse quotations, which remain firm. In local lighting and street railway securities, the market has everywhere been excellent, April and May earnings being of a highly encouraging character in most instances.

WESTINGHOUSE ELEC. & MFG. CO.

The annual meeting of the Westinghouse Co. was held at Pittsburgh on May 15, but it adjourned until July 17 and no reports or figures were presented.

WIRING BIDS WANTED.

The Treasury Department, Washington, is inviting proposals for electric wiring for United States Public Buildings, as follows: Monroe, La., bids opened May 27; Philadelphia, Pa., bids opened May 27; Paducah, Ky., bids opened May 22.

A GENERAL ELECTRIC LAMP MAKER'S CURIOUS SUIT FOR DAMAGES.

Suit has been brought before Judge Child and a jury in Newark, N. J., by Erhardt Bruder, who was employed in the Edison Lamp Works at Harrison. He asked damages in $5,000, alleging that the General Electric Company has ruined his health. He was employed in the room where the mercury pumps for exhausting the air from the lamp bulbs are. He asserts that when the bulbs break, the mercury is scattered over the operatives, and that as a result his whole system has become poisoned. His hair, he says, is falling out, his teeth are loosened, his sight and memory are impaired, and his limbs weakened. It is said that the fate of four or five other cases will depend upon this suit.

THE ESSICK TYPEWRITER TELEGRAPH.

The well-known Essick typewriter telegraph is being brought forward just now as a competitor with both telegraph and telephone. There is no good reason why it should not find a place. It conveys a message from one typewriter machine to another, and prints the type not in ribbon form but in a page sheet. The Consolidated Telegraph and News Co. has been formed in Pittsburgh to handle it and state companies are being formed. J. A. Davis, of New York, is secretary of the company.

AN ELECTRIC POWER COAL HANDLING PLANT AT SAN FRANCISCO.

An extensive coal handling plant, operated entirely by electricity, has been running in San Francisco for the past few months with the greatest success. The plant is of the most modern character in every respect, and is the second important coal handling plant operated by electricity installed in this country. The owners, R. Dunsmuir & Sons, being confronted

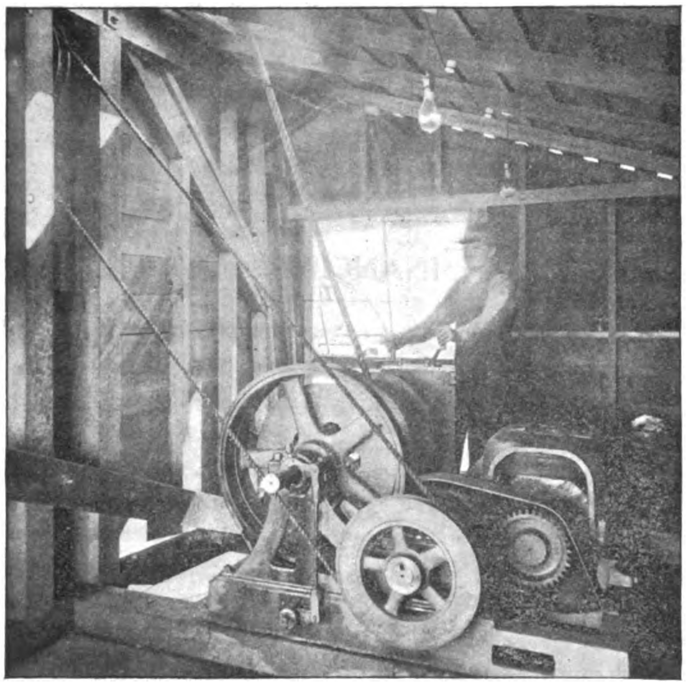


Fig. 1.—Coal Hoisting Plant, San Francisco.

with the problem how to unload coal rapidly from the steamships and colliers at the wharves, and distribute it to the wholesale and retail trade, most economically, found the solution in the adoption of electrical apparatus; and the contract was awarded to the General Electric Company.

The San Francisco plant consists of an electric hoisting and haulage system for unloading the coal-carrying ships and steamers and distributing the coal into wharf and house bunkers for local and wholesale distribution. It is located on the water front of San Francisco, about four blocks from the ferry entrance to the city and within a half mile of the business centre. The bunkers consist of two parts, the wharf bunkers and the yard, or house, bunkers. The former are built out upon the pier by the side of which the colliers are moored for discharging. The yard bunkers are located in the main yard, on the side of East St. and are connected with the wharf bunkers by means of a trestle and bridge 204 feet long and 35 feet above the level of the street. The main yard consists of a dock 350 feet by 300 feet, and here the main bunkers, screening bunkers, power house, offices, stables, and the storage yard are located. The wharf bunkers are 290 feet long by 86 feet in width and have a capacity of 1100 tons of coal. The yard bunkers are 241 feet long by 60 feet in width and have a capacity of about 5000 tons.

The power house is a frame building 31 feet long by 88 feet in width. The boiler plant consists of three 66 inch by 16 feet boilers, each of which contains sixty-four 4 inch tubes and is rated at 100 H. P. In the dynamo room are two 11 x 18 x 14 tandem compound McEwen high speed 135 H. P. engines, running at 265 revolutions. Belted to these engines are two 90 K. W. 250 volt, compound-wound, multipolar General Electric dynamos, running at 700 revolutions and overcompounded 10%. The load on the dynamo is extremely variable, often changing from no load to 75% of full load in from 5 to 10 seconds, and from full load to no load in about the same time. Even under these exacting conditions, the entire generating plant is giving close regulation and perfect satisfaction.

The hoisting plant consists of three special electric hoists, each having a capacity of 2000 pounds lifted at a maximum rope speed of 800 feet per minute. An excellent idea of these hoists is given in Fig. 1. The motors are of the General Electric L. W. P. 20 type, and the armature shaft is geared to an intermediate shaft by special gears with a very slight reduction in speed. The intermediate shaft is in turn geared to the drum shaft by means of eight groove "V" frictions. On the end of the intermediate shaft, is also a single groove wheel driving the hauling-in drum which serves to haul in the bucket over the chutes when it has been raised to the proper height. The hoists are controlled by means of "K. R." controllers, of the usual well-known type, and are mounted in derrick houses as shown in the illustration.

Fig. 2 shows the steam collier "Costa Rica" lying alongside the bunkers, and unloading partly into the cars for distribution into the yard bunkers, and partly off shore into the ship "George Skolfield" moored beside her. The bucket is just about to be unloaded into the chute by which the coal will pass into the cars. These buckets have a capacity of 1200 pounds of coal each and are raised from a depth of 60 feet to 80 feet according to the state of the tide and the portion of the hold from which they are taken. The derricks are mounted on a track raised about 6 feet above the floor of the bunkers, and are so arranged that they can be moved along the wharf to accommodate themselves to the position of the hatches of the ships. The capacity of each derrick is 400 tons in 9 hours, although they have, under favorable conditions, worked up to 450 tons in 9 hours.

A portion of the coal is unloaded directly into the bunkers on the wharf, and is distributed from them into the retailers' wagons. By far the larger portion, however, is discharged into cars and hauled into the house bunkers, to be distributed as needed.

Fig. 3 shows one of the electric locomotives, of which two are used for this haulage work, with a train of four cars being weighed on the scales before delivery to the house bunkers. The locomotive is of the well-known "T. M. F." type and is equipped with General Electric motors. The locomotive has a draw bar pull of 800 pounds and is required to haul from four to six loaded cars, each car weighing 3,600 pounds and having a capacity of 4,700 pounds of coal. The train in Fig. 3 represents a gross load of 40,670 pounds. The tracks are perfectly level and on the return trip the locomotive frequently brings back 8 to 10 empties. All the coal is weighed before being delivered to the house bunkers—track scales being made a portion of the track and each car being weighed independently. The capacity of these bunkers is about 5,000 tons of coal.

On the bridge, the usual overhead railway construction has been adopted, while on the wharf a special construction, shown in detail in Fig. 2, was rendered necessary on account of the limited head room underneath the derrick.

These bunkers handle the output of the well-known Welling-

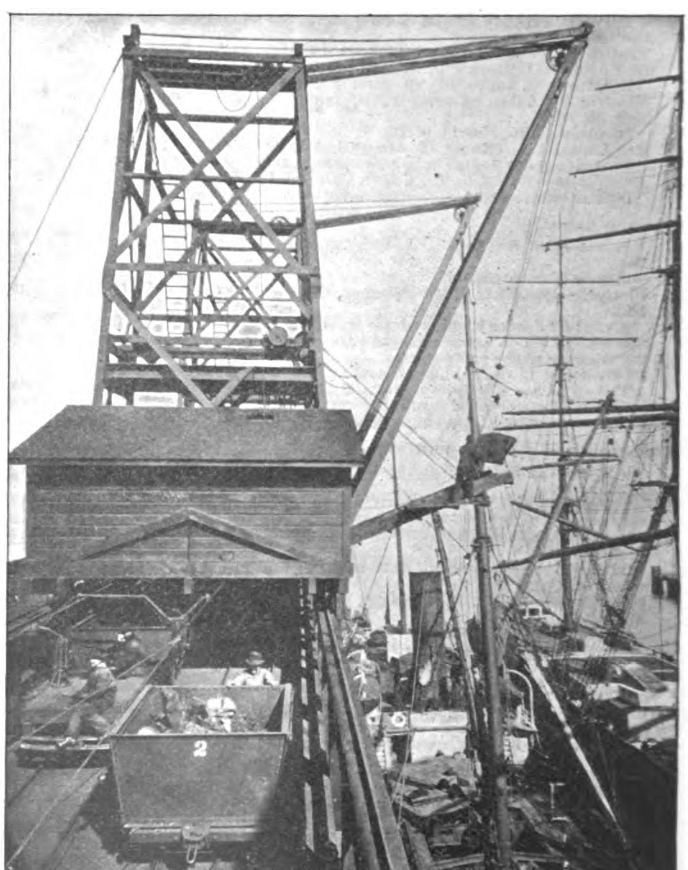


Fig. 2.—Steam Collier Unloading by Electricity, San Francisco.

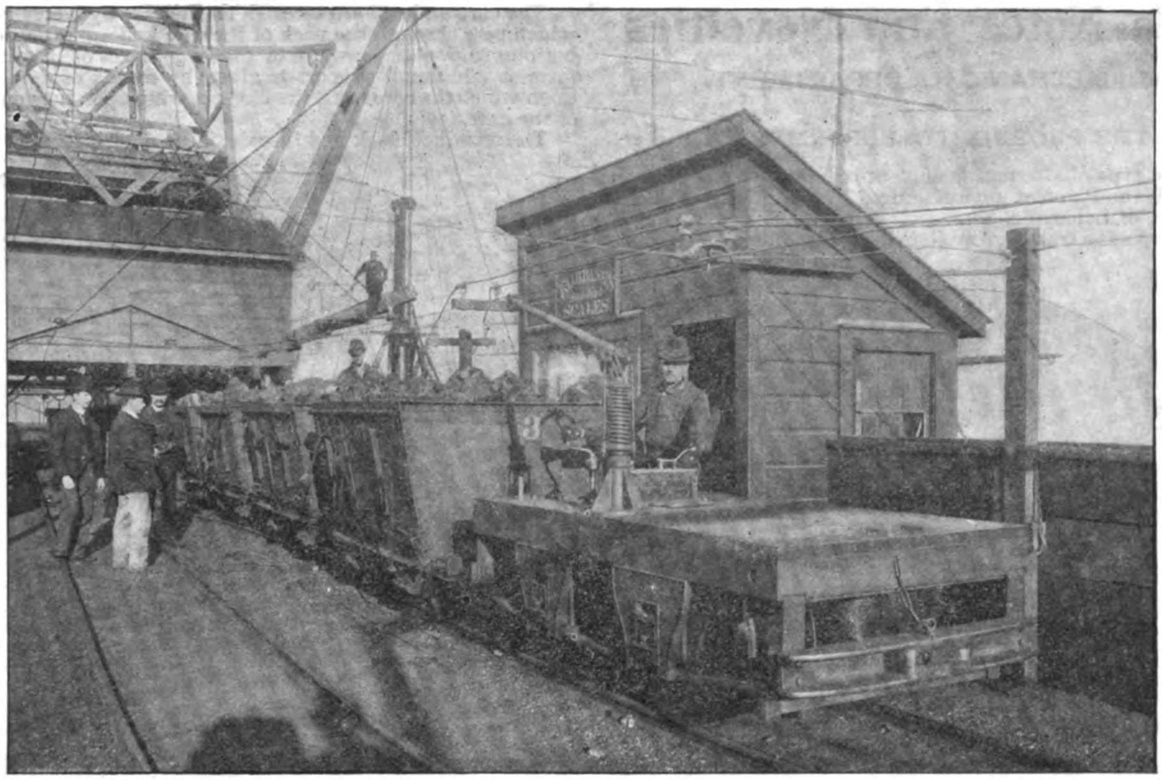


FIG. 8.—ELECTRIC COAL TRAIN ON WHARF, SAN FRANCISCO.

ton Mines at Wellington, B. C., which is estimated at about 450,000 tons per year. Of this about 250,000 tons are handled through these bunkers, the balance being shipped direct to wholesale dealers. The plant has been in continuous operation since the 4th of February and has given the most perfect satisfaction throughout.

EDUCATIONAL.

THE WORK OF THE COOPER UNION NIGHT SCHOOLS.—AN APPEAL.

THE night schools of the Cooper Union have for twenty-five years furnished to the men and women of New York City who are unable, through lack of means or time, to pursue a collegiate course elsewhere, an opportunity to acquire a mathematical and scientific education such as would fit them to find employment in engineering, architectural or other professional work. Thousands of earnest men and women have availed themselves of the opportunity thus offered, while pursuing their regular vocations and earning their livelihood, to fit themselves for a higher sphere of usefulness; and many of the graduates of this school have taken high rank in the engineering profession and are to-day filling responsible positions because of the help they obtained in the Cooper Union classes.

Generous as was Peter Cooper's gift to the working people of New York, and useful as is the work accomplished, more might be done with larger funds. The advance of science and the useful arts especially in the domain of physics and electricity has been so rapid that it has been impossible to keep the facilities for instruction abreast of the times, and the usefulness of the school could be greatly enlarged by an addition to its collection of apparatus. Especially is this true in the department of electricity. There is an entire lack in the collection of all apparatus for electrical measurements, motor, or anything in fact to represent the electrical progress of the last forty years.

There is a demand to-day for instruction in physical and electrical science that did not exist twenty, or even ten, or five years ago. The Cooper Union night school can do something to meet that demand, but the collections of apparatus should be brought up to date to enable it to do all that is needed. Those collections were excellent for the work then demanded. The fund left by Peter Cooper is doing all it can, but the work of the Cooper Union has grown to such an extent that it is impossible for it to do all that is needed. Is there not someone interested in promoting the welfare of the seekers for scientific knowledge, who will help the cause by assisting to provide modern apparatus and appliances for instruction?

THE ROSE POLYTECHNIC INSTITUTE.

We have received a copy of the thirteenth Annual Catalogue of the Rose Polytechnic Institute, of Terre Haute, Indiana. This Institute was founded in 1874 by the late Chauncey Rose, of Terre Haute, and was opened in 1883. It is devoted to the higher education of young men in Engineering. The Electrical Engineering department is well equipped, and includes a complete electrical plant consisting of a 50-horse-power compound engine, 36,000 watt alternating current Westinghouse dynamo complete, with transformers of from 250 to 2,500 watts capacity of various voltages and manufactures, arranged for experimental work. There is also a model lighting plant of 150 lamps, with switch-board and station instruments and everything necessary for the practical illustration of electric lighting installations. A special testing and standardizing laboratory is provided. Besides these and many other advantages, the extensive street car plant and the several light and power stations in the city have been placed at the disposal of the students for experimental work and instruction.

MAGNETIC FIELD PICTURES.

FOR the purpose of demonstrating the configuration of the magnetic field obtained from magnets with free poles, the image of the lines of force given by iron filings has come to be a recognized adjunct of every electrical class room. A number of processes have been advised for fixing the iron filings but for beauty and sharpness in this class of work none has exceeded some magnetic figures which we have recently had the pleasure of inspecting. These are the work of Mr. E. T. Schoonmaker, of Fordham, N. Y., who is making a specialty of this work. These iron filing curves are mounted on glass with white background and protected by a glass cover. A number of institutions have already procured these magnetic images, which are not only highly instructive but, as Mr. Schoonmaker prepares them, a most ornamental addition to any class room, office, or library. One of these pictures, which will give a fair idea of the series, can be seen at the office of THE ELECTRICAL ENGINEER, 203 Broadway, New York.

ARC LIGHTING SUPPLIES WANTED AT WESTMINSTER, MD.

The people of Westminster, Md., have voted for arc lights, and the Carroll County Electric Co. will put in a 40-light arc machine. The Company will be glad to hear from concerns selling arc supplies. Mr. A. R. Lakin is electrician, and Mr. F. D. Miller secretary and treasurer.

Bids close on May 28, for the supply of about 30 arcs of 1,600 C. P. and 10 or more incandescents of 32 C. P. for the city of Mechanicsburg. It is expected that the plant put in will provide for additional lighting. J. S. Huston is chairman of the Light Committee.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PHOENIX TRANSFORMER.

The latest type of alternating current transformer placed upon the market is the Phœnix, manufactured by the Louisville Electrical Works, of Louisville, Ky.

Fig. 1 shows the transformer complete, ready for installation,

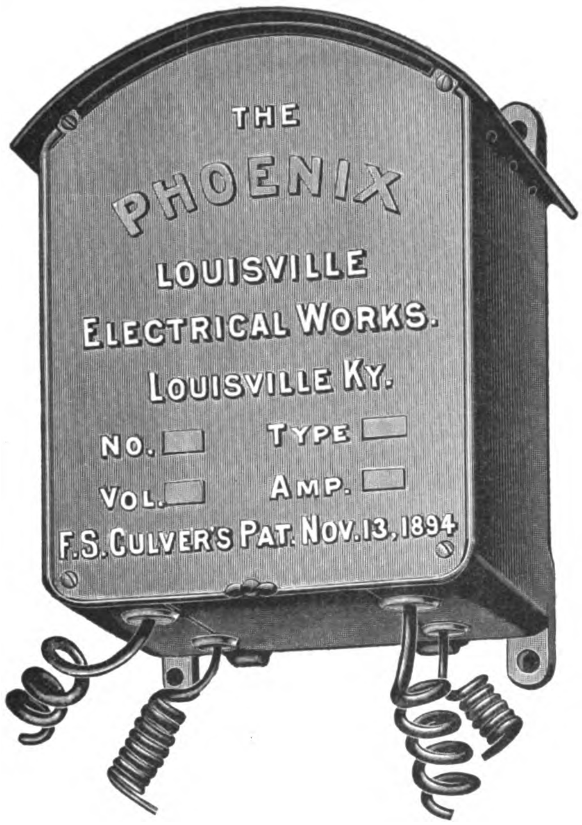


FIG. 1.—THE PHŒNIX TRANSFORMER.

while Fig. 2 gives a clear idea of the interior when the cover is removed and the door lowered. In the latter view the core, coil, fuse device, insulators, etc., may be clearly seen in their respective positions. In Fig. 3 the core and coil are shown as partially assembled.

The transformer cases are strong and durable, thoroughly ventilated and waterproof. The ventilation is effected by the cool air rising through the slots in which the porcelain insulators are loosely placed, the warm air finding exit through the several small holes under the projecting eaves at the top and sides of the case. The cover of the case is secured by four screws after having been leaded and made waterproof, while access to the fuse plugs is had through the small hinged door at the bottom of the case, which is secured by but one thumb screw. An improvement upon the usual forms of screw insulators usually employed, which are so readily broken, may be seen in the strong porcelain insulators which are slipped in slots in the bottom of the case to the sides of the door, and there are held in position by split pins.

The coils are insulated with the highest grade of insulating material and the leading wires are widely separated from each other and the iron of the core and case, and lead down through the porcelain terminal block and out through the insulators, making it impossible for the terminal wires to become grounded or short-circuited.

The core is formed of soft steel L-shaped plates, which are securely bolted together in four interchangeable L-shaped sections. Through special treatment and preparation this form of core renders a perfect magnetic joint possible where the sections come in contact, and makes the core exceedingly simple and convenient to build up. The sections of the core are held rigidly in position by means of long screws which are passed through heavy wrought iron clamps, which embrace the core as shown. By using treated strips of wood the core is perfectly insulated from the screws, clamps and the case. As will be seen, to remove a coil from the core requires but a very few minutes.

The core and coil are secured in the case by heavy cap screws which pass through the back of the case and are screwed into the bottom iron clamps; while in the larger sizes of Phœnix transformers additional support is given by means of a wood block upon which the core rests, the block bearing upon lugs on the sides of the case.

The terminal block and fuse device is made of heavy porcelain

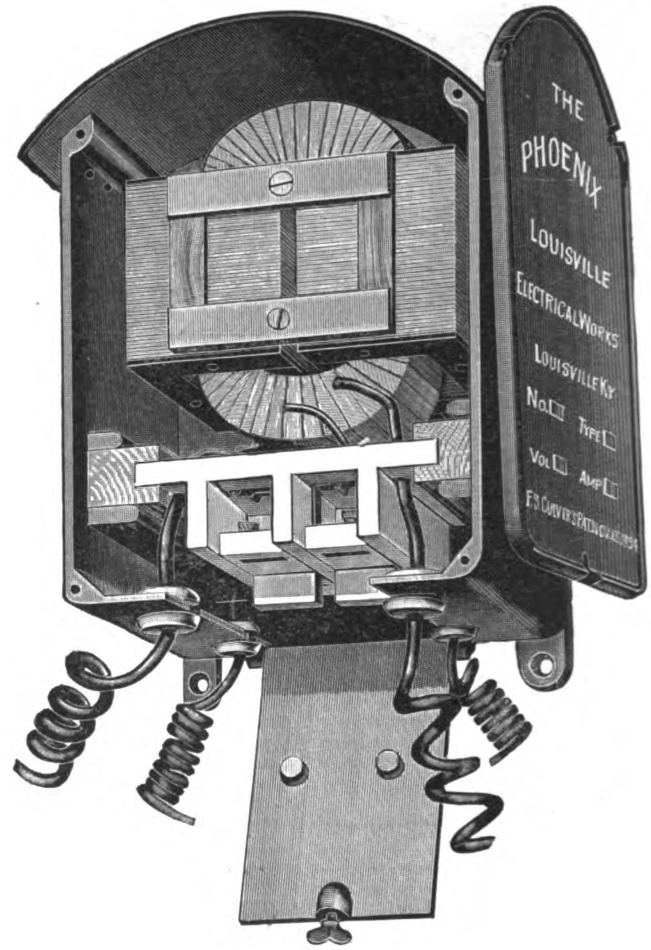


FIG. 2.—THE PHŒNIX TRANSFORMER.

and is secured in the case between two moulded wood blocks, held in position by light lugs cast on the sides of the case. The fuse plugs are all interchangeable and are made of heavy porcelain, with a convenient thumb piece on the bottom and a slotted porcelain bridge on top, through which the fuse passes. On the

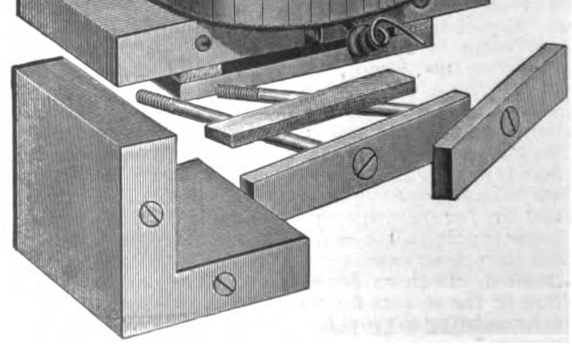
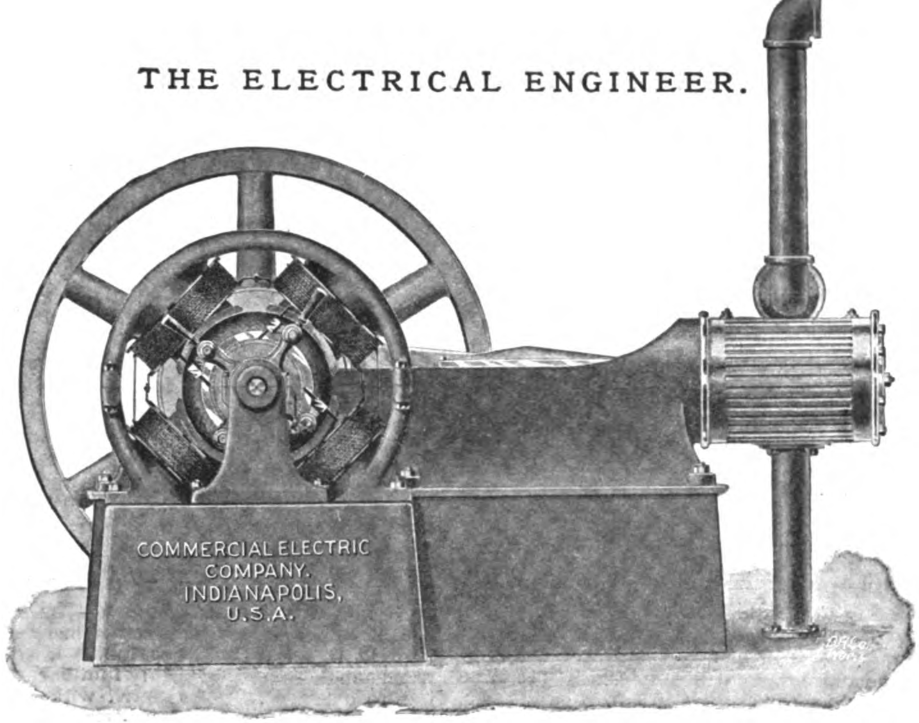


FIG. 3.—THE PHŒNIX TRANSFORMER CORE.



THE COMMERCIAL ELECTRIC COMPANY'S DIRECT CONNECTED DYNAMO.

plug are screwed two contact blades, bevelled on the edges, and upon which are placed the thumb nuts for securing the fuse wire. The contacts on the fuse block are placed between thick porcelain walls, each consisting of a brass strip, bevelled on one edge, while above is a wider strip of brush copper. The fuse plug is slipped between the walls on the block, when the blades on the plug slide between the brass and copper strips, making a tight and secure sliding contact. The construction of the fuse plug makes it as good a circuit-breaker as a jack knife switch, and is also one in which it is impossible for the melted fuse to injure any one. The device being open at the ends gives ample vent for the gases or heated air formed when the fuse blows, rendering it impossible for the plug to become broken. The two projecting pieces seen on the door come into position in front of the thumb pieces when the door is closed, making it impossible for the fuse plugs to come out of position.

The Louisville Electrical Works, are prepared to fill all orders for standard sizes of these transformers promptly, and upon application will send their catalogue fully describing the merits of the Phœnix transformer.

YOUNGLOVE & GERE.

Younglove & Gere, successors to the firm of Cherry & Younglove, now dissolved, announce that they will continue to manufacture the well-known Cherry & Younglove ventilated dynamo brush, for incandescent dynamos, plating dynamos, alternating generators and exciters, electric railway generators, and stationary motors. The new firm will, in addition, handle a few specialties, such as incandescent lamps, shade and shade-holders, lamp cord, wires, tapes, electric bells, batteries, etc., as well as general gas and electric fixtures, both independent and combined. The dynamo brush, with which the success of the name of Cherry & Younglove has been so closely associated, is manufactured of the best high conductivity copper gauze, made especially for them from pure lake copper.

Their headquarters are 14 Grand Opera House Block, Syracuse, N. Y.

PHILADELPHIA ENGINEERING WORKS (LIMITED).

The Philadelphia Engineering Works (Ltd.), are taking a leading place in the manufacture of steel plate chimneys, and among other of their specialties are iron tanks, stand pipes, steel buildings, blast furnace equipments, Gordon-Whitwell-Cowper fire brick hot blast stoves, Philadelphia Corliss engines, blowing engines, and air and gas compressors. The steel chimneys already supplied by the firm to over 60 prominent works range from 3 feet diameter by 125 feet high, to 11 feet diameter by 225 feet high. These chimneys have received on an average not more than one coat of paint in five years. The prevalent idea that iron or steel plate chimneys are mere frail tin affairs requiring guys, and quite inadequate to the needs of an extensive business, is entirely erroneous. Some of the largest chimneys in existence are of iron or steel. Their shafts, rearing 200 to 300 feet in the air, are not only an excellent protection against lighting, but an efficient advertisement, which is an important consideration now-a-days.

THE COMMERCIAL ELECTRIC COMPANY'S DIRECT CONNECTED DYNAMO.

We illustrate herewith the direct connected generators of the Commercial Electric Co , Indianapolis. The dynamo is of the well known multi-polar type made by this Company. It has soft cast steel field magnets, and a smooth Gramme ring armature. The maximum rise in temperature is guaranteed to be less than 75 degrees Fahrenheit and regulation within one volt from no load to full load. The armature is commonly mounted on the extended shaft of the engine and the frame upon the extension to the engine sub-base. The armature and commutator are mounted on the same spider, so that the complete armature may be removed from the shaft without disturbing any of the connections.

The machine illustrated is a 40 K. W., lighting dynamo connected to the Ball Engine. The experience of the many users of these machines, fully bears out the Company's claims for them.

J. GRANT HIGH & CO.

A descriptive circular, catalogue and price list of switches, switchboards and electrical specialties has been received from J. Grant High & Co., 123 North Third St., Philadelphia, Pa. The capital of the company has just been doubled, and their facilities for the manufacture of their specialties have been greatly improved by important additions to their plant. The company claim that the efficiency of their switches is doubly assured, first, because they are designed by competent draughtsmen; second, they are cast out of the best alloy of metal, making them finish like gold, and giving them the maximum carrying capacity; third, they are made by experienced mechanics only; fourth, their carrying capacity is carefully rated, and they are guaranteed not to heat; fifth, all the switches have hard-rolled copper blades and jaws and make perfect contact. They are mounted on selected Vermont slate bases, free from conducting veins. The company have devoted much attention to the improvement of their connections for heavy conductors.

WESTERN NOTES.

The Metropolitan Electric Company, 186-188 Fifth Avenue, Chicago furnished the lamps for the large spiral tower of A. M. Rothschild & Co.'s new store (recently illustrated in the Engineer). This tower has created a sensation and the Metropolitan Company feel that they have "scored a hit" by having their lamp selected.

The Metropolitan Electric Company, 186-188 Fifth Avenue, Chicago, are advising their customers and the trade generally, that while they are willing to meet competitive prices on high grade rubber wire, the National India Rubber Company, manufacturers of N. I. R. Wire, will not enter competition upon the low grade of cheaper wires that have been foisted on the market. They prefer to keep up the high excellent standard of this wire, feeling that in the long run, it will be to the advantage of the business at large and the wire in particular.

WESTERN NOTES.

MR. G. E. PAINE has been appointed Postal Telegraph manager at Chicago, in place of F. G. McCurdy.

THE UNITED MOTOR Co. has been formed at Cleveland by J. H. Hoyt, H. H. McKeeban and H. A. Kelley, to manufacture electrical instruments.

PLATTSBURG, MO.—The contract for complete electric lighting plant has been awarded to the Franklin Electric Co., of Kansas City, Mo.

THE CHARLESTON ELECTRIC COMPANY, Charleston, Ill., has been incorporated with a capital stock of $5,000 by F. A. Brooks, W. A. Hyland and Richard Cable.

THE ELECTROLYTIC INSULATING AND CONDUIT COMPANY has been incorporated at Springfield, Ill., with a capital stock of $5,000,000, by H. C. Wilson, Benj. Knudson and James E. Henderson.

MR. B. J. ARNOLD, the well known electrical engineer, has leased an elegant suite of offices at 1540–41–42 Manhattan Building, Chicago, where he will be better able to give proper attention to his business.

THE PEORIA GENERAL ELECTRIC Co. have asked the City Council for a new franchise. The one they are now working under was granted to the old Jenney company nearly 14 years ago. They ask for a franchise to permit them to rebuild their lines and increase their capacity.

MR. LUCIUS T. GIBBS, of the Gibbs Electric Company, Milwaukee, ran down to Chicago last week to look after some important contracts. Mr. Gibbs reports business as very good, his company having enough unfilled orders on hand to keep them busy for three or four months to come.

THE CENTRAL ELECTRIC COMPANY, Chicago, report a very encouraging demand for the Pharos incandescent lamp. Like many other specialties handled by this company, the Pharos lamp is not merely good, but "is the best." This probably accounts for the many orders coming in at a time of the year when the lamp trade is usually dull.

MR. R. LEO VAN DER NAILLEN, Californian by birth, who has held many important positions on the Pacific Coast, has been appointed Western Manager of the Boudreaux Dynamo Brush Co., with headquarters at Chicago. Mr. Van der Naillen is a practical engineer, whose abilities will certainly be appreciated by all the Western patrons of the Boudreaux Co.

THE CHICAGO SUBWAY ARCADE AND TRACTION COMPANY was incorporated at Springfield, Ill., on the 3d inst. with a capital stock of $15,000,000. C. F. Griffin, M. E. Barnhart and J. K. Nelson are given as the incorporators, who at present are rather reticent about the company's plans. The object of the company, as stated in the charter, is to construct subways in Chicago and operate a line of cars with dummy engines.

PROF. J. P. BARRETT.—The numerous friends and acquaintances of Prof. Barrett will be pained to learn of the death of his daughter, Marion, a charming young lady of 23 years. Miss Barrett had been suffering from lung trouble for some time, and in spite of all efforts on the part of the best physicians she died on the 11th inst. THE ELECTRICAL ENGINEER extends its hearty sympathy to Prof. Barrett and family in their sad bereavement.

THE ELECTRIC APPLIANCE COMPANY are receiving a large number of inquiries regarding their new Meston alternating current ceiling fan which promises to find fully as useful, if not as large a field, as the regular Meston alternating current fan. As this is practically the only alternating current ceiling fan on the market, it should certainly prove a good seller during the coming season.

THE LIGHTING PLANT OF A. M. ROTHSCHILD & Co., Chicago, containing the first installation of the Thompson-Ryan dynamos was started on the 10th inst., a number of gentlemen being present by invitation of Messrs. Wm. Sharpe and C. M. Barkley of the Chicago office of the McEwen Engine Company. The engines and dynamos worked perfectly and elicited much praise from those present. In addition to the gentlemen mentioned there were present Mr. Milton E. Thompson, one of the inventors, Messrs. R. St. John, W. A. Remington, W. J. Phelps, Jas. Boyd, Jno. McAuley, C. W. Forbrick and Carl Kammeyer.

THE GARDNER ELEVATOR Co., 123 & 125 Congress street, Detroit, has the contract for five electric elevators to go in the new Valentine Building at Toledo, O. This building is being put up by G. H. Ketchum, to be used jointly as an opera house and an office building. The city has rented most of the office space. The Gardner Co. do all the elevator work, but use the winding gear and electric motors of the Elektron Co. of Springfield, Mass. The motors will be 20 H. P. each, run on the 110 volt circuit from the isolated plant. The elevators will have steel guides, ornamental cars and lever operating devices, indicators, etc.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE Co., of East Berlin, Conn., are putting up an iron bridge at Thomaston, Conn., consisting of two plate girder spans, each 60′ long, with a roadway 23′ wide, and two sidewalks, each 6′ wide. The bridge will be made entirely of iron and concrete, no woodwork being used in the construction.

BELLOWS FALLS, VT.—The additions to the plant of the Westminster Paper Co., Bellows Falls, Vt., are now completed. The new machine room is 40′ wide and 185′ in length, covered with one of the Berlin Iron Bridge Company's patent anti-condensation corrugated steel roofs.

ALMON & SARGENT have completed the municipal plants at Morrisville and Johnson, Vt., and have about 2,200 lights installed in the two towns. They are installing about 1,500 lights capacity, using Ft Wayne Elec. Co. alternator and 100 H. P. power circuit using a Belknap Motor Co. 75 K. W. generator. They have also just completed the wiring of the Dormitory at the University of Vermont, Burlington.

CANADIAN NOTES.

BOUDREAUX DYNAMO BRUSH.—The sole agency for the Boudreaux dynamo brush in Canada has been granted to K. E. T. Pringle, Imperial Building, Montreal, who being a dealer in electrical supplies and thoroughly familiar with everything pertaining to dynamos, brushes, etc., will no doubt meet with great success in the sale of this anti-friction metal brush.

NEW YORK NOTES.

MR. FRANCIS R. UPTON.—We have been requested to announce that this gentleman has no connection whatever, of any kind, with the "Upton arc lamp."

THE CHAPIN-DOUGLAS ELECTRIC Co. has been formed with a capital of $10,000 to deal in electrical apparatus, by Chas. E. Chapin, John S. Douglas and F. F. Douglas.

THE KITSEE ELECTRIC Co. has been formed at Camden, N. J., with a capital of $75,000 to build dynamos, motors, etc. The incorporators are J. M. Carroll. of Camden; G. J. Tierney and R. A. Balfour, the last named of Philadelphia.

THE METROPOLITAN STREET RAILROAD Co. has been given permission to use its underground trolley system in the upper part of the city. The speed of the cars on Lenox Avenue is limited to ten miles an hour. Cable for the current is now being laid along the line, in the ducts.

MR. W. WORTH BEAN, president of the St. Joseph & Benton Harbor, Mich., Elec. Railway & Light Co.,—one of the active spirits of the American Street Railway Association was a welcome visitor to New York last week, and, naturally enough, was to be seen in close company with Mr. J. H. McGraw of the *Street Railway Journal*.

MR. GEORGE W. RUSSELL, JR., E. E., of Denver, after knocking around half the globe and three quarters of the United States, is now favoring New York with a call, in the interests of the ingenious Russell automatic switch, which has been most emphatically endorsed by the Western underwriting bodies. There is plenty of room for it in the East.

THE FERRACUTE MACHINE Co., Bridgeton, N. J., manufacturers of presses, dies and sheet metal tools generally, are feeling the general revival in business, in common with many other large concerns. A considerable portion of their efforts just now is devoted to keeping abreast with the orders that have been pouring in. They are running a full force, and working one or two nights each week.

THE ELECTRIC ENGINEERING & SUPPLY Co., of Syracuse, have recently moved their New York office and store room from 136 Liberty street to the Thames Building, corner Greenwich and Thames streets, room 205. This office and store room will be under the management of Mr. F. M. Hawkins, and there will be kept constantly in stock a full line of their well-known specialties, knife switches, sockets, rosettes, etc., etc.

THE HACKENSACK, N. J., EDISON LIGHTING COMPANY has filed in the office of the county clerk an amended certificate of incorporation. The paid up capital is $25,000, in 250 shares, credited to H. Ward Leonard and Joseph F. Moshler of New York City and Alfred O. Tate of West Orange. Frank B. Poor is president and William C. Thomas secretary of the company, which is the one that recently purchased the Hackensack electric-light plant. A new power house is now being built near the gas-works.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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THE MEXICAN GOVERNMENT TELEGRAPH SERVICE.—THE ZONE SYSTEM OF RATES.

BY

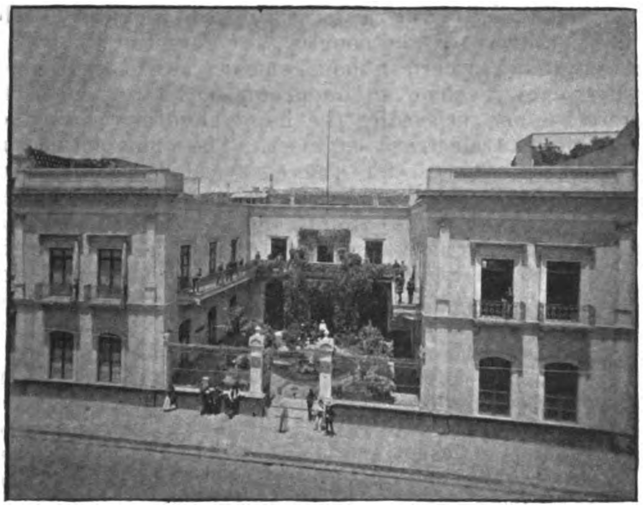
George Heli Guy.

I.

Saturnino Islas.

Mexico is the land of romantic history. From the middle of the seventh century, when the mysterious Toltecs dropped down into the picturesque Tula valley, and there making their capital, leavened the country with a new and pregnant civilization, to the advent of the Aztecs, 500 years later, and then on through the Montezuman era in the sixteenth century, when the Spanish navigators began to explore the New World, and authentic Mexican history really began, to the present time, there has been a peculiar fascination for the rest of the world in the country that lies between the great gulf which bears its name and the Pacific, and which stretches upwards from the tropics to the temperate regions. Within it were mighty resources, and no one knew how soon the day of their development might come. It is now close at hand. Under the enlightened government of President Porfirio Diaz, the railway system has been built up, education has spread, and industries have been protected and encouraged. The revenues of the Republic have more than doubled in the last 20 years. In 1870 they were $16,000,000 ; they are now estimated at $40,000,000. Over two-thirds of the exports go to the United States, and the trade between the two countries, each of which has products required and not produced by the other, is rapidly expanding. Mexicans are eagerly and hopefully looking to the outcome of the year 1896. The great scheme of draining their capital, which has been in progress for many years, will then be completed, and Mexico, unsurpassed in beauty of situation, climate, and historical interest, will be one of the healthiest cities in the world, "the Paris of the American continent," a city that for a winter sojourn or a permanent home, stands almost unrivalled. Next year will also see the opening, at the foot of the Castle of Chapultepec, just outside the city, of "Mexico's First and Great Exposition of Industries and Fine Arts," which has for its object the "cementing of closer commercial relations with foreign countries, and the advancement of her trade and prosperity." This exposition means almost as much to Americans as it does to Mexicans. The leading railway of the country, the Mexican Central, is entirely under American management ; Mexico will be for many years to come an important outlet for American enterprise, and especially the happy hunting ground of the American electrical engineer. The many actual and prospective schemes for the electrical transmission of power throughout the country, are nearly all dominated by American skill and capital, and the general electrical field is wide, attractive, and full of promise. What the country can do under vigorous and judicious stimulation is pointedly shown in the history of the Government telegraph service, during the last ten years. In 1885 the Mexican Federal Telegraph system was absolutely chaotic, inefficient, and corrupt. In other words, it was in the hands of unscrupulous political powers, who played it for all it was worth. The sending of messages was a farce. The central office had a dilapidated battery room, filled with quaint old obsolete instruments, and the operators were the oddest aggregation of beings that ever pounded a key. They consisted mainly of minor politicians and hangers-on who had the barest possible acquaintance with telegraphy. If the operator happened to know anything of his business, the sender was in luck ; if he did not, the message was pushed aside, and presently pitched into the waste paper basket. Fully half the messages were never sent, and a large proportion of those that were dispatched were not received within 10 days after they left the office. Out on the lines, matters were not a whit better. It was estimated that over 50,000 poles were down, and the miles of line without wire were simply beyond calculation. The peon appreciated the line thoroughly ; the poles provided him with firewood, and he used the wire for fencing in his cattle. If a man wanted to give a traveller a piece of friendly advice, he would warn him to cross the lines only in daylight, as horsemen occasionally had their necks nearly severed by low hanging wires into which they rode at dawn or in evening twilight. On whole sections there would be not a single lineman to look after the line, and at little country offices, where a boy could do all the business, would be stationed a corps of five men, whose principal occupation was smoking cigarettes and drawing their salaries. As a travesty, the service would have been pronounced by outsiders crude and exaggerated; as a fact it was an outrage on a civilized community. Matters had reached this pass when President Diaz determined to include the Government telegraph system in the plans for civil service reform which have signalized his progressive administration. The telegraph bureau is under the department of public works, of which the minister was then General Carlos Pacheco, one of the ablest and most patriotic statesmen Mexico has seen. Out of the prevailing chaos of wrecked lines, rotten poles and worse than useless employees, some one had to bring order and efficiency, and General Pacheco, with the fine instinct of many successful commanders, hit on the right man to do it. Mr. Saturnino Islas, who had done zealous and effective service in the Vera Cruz railway telegraph service, had shown himself possessed of exceptional practical and administrative qualities. He had studied modern telegraphy in the United States, and had mastered every branch of his profession. The work of reorganization was offered to him. He accepted it, with the proviso that absolute power be given him in the

matter of changing the personnel of the service. On assuming the office of Director General of Telegraphs, Mr. Islas's first step was to begin the repairing of the lines. They were nearly all prone on the ground, and there was no communication 100 miles from the city. This cheering state of things was owing to the fact that the Government had been accustomed to contract for the repairs on the lines. The contractor invariably

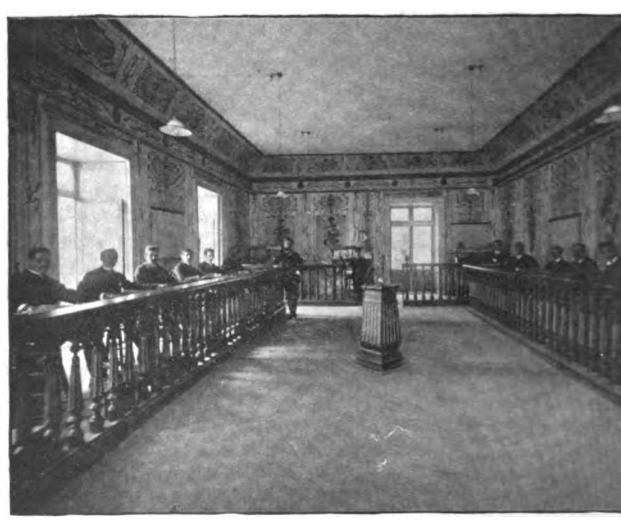


HEADQUARTERS, MEXICAN GOVERNMENT TELEGRAPHS.

put the money in his pocket, and let the lines go. The working instruments were changed, modern forms replacing the old material. The many types of European makes were superseded by instruments of American manufacture. The next step was the reorganization of the staff. Sweeping changes were made, and new blood was introduced, but many of the principal employees were left in their positions. The incompetent hands were weeded out, and the most efficient were retained. The selection was well advised, and the staff has practically remained unchanged up to the present time. A new distribution was also made of the length of section supervised by each inspector, and the number of inspectors was increased. Nearly 1000 miles is now given to each man, on which basis the service is efficiently maintained. The system extends to every town and seaport of importance in the Republic; to the United States frontier on the north, and to the Guatemalan line on the south. It comprises 306 stations and 41,868 kilometres of line, and it is so complete that the Government has the command of any required information from any part of the country at a moment's notice. The old public tariff was a minimum of 25 cents and a maxium of $3. The improved tariff is a minimum charge of 20 cents for 10 words, and a maximum charge of $2. The lower charge covers the city and a radius of 180 kilometres; beyond that there is an increase of 20 cents for every 180 kilometres or fraction of the same. The Federal system recently swallowed up the Commercial Telegraph Company, whose lines extended from the capital to Vera Cruz, tapping the important city of Puebla. The Government policy is one of gradual absorption of private telegraph enterprises, as in England. Even the railroad telegraph facilities have been suspended in the more important cities, where they have hitherto reaped a harvest from telegraph receipts. There is a distinct tendency, however, to improve the service—in spite of this virtual monopoly,—and the amelioration of the Government telegraphs in Mexico within the last five years is decidedly marked. Not being a purely commercial enterprise, but intended mainly for Government purposes, and as an adjunct to the army and its operations, the federal telegraph service is not expected to pay a large dividend, but under the vigorous hand of Mr. Islas, it has more than realized the most sanguine expectations of the administration. Mexico has, in fact, set an example in the correction of civil abuses, that the United States might well follow, and has demonstrated that an economical and efficient telegraph service can be secured under governmental supervision. The country has been peaceful for many years past. The revolutionist's occupation is gone. The wire brings to the capital instant information of any ferment, and before the trouble has had time to become a menace, the railways can carry troops to the spot. Commercial methods have also been quickened and improved, and the telegraph and the railway have begun a new era of prosperity for Mexico.

II.

The Federal Telegraph lines are in charge of a "Directorate-General," subordinate to the office of the Secretary of Communications, and considered as a special section of that department. The Administration, or Executive Department is composed of a director, who acts in consultation with the Secretary of Communications, and of five sections, to wit: The first, in charge of construction and maintenance of the lines; the second, in charge of the service and personnel; the third, of the distribution of stores and materials; the fourth, of the accounts and auditing the books of the branch offices; and the fifth, of the records and statistics. The first section is composed of one chief, one deputy, and one draughtsman; the second and third of a chief, a deputy and an assistant; the fourth of a chief, two assistants, and two clerks; and the fifth of one officer, and two clerks. The department also includes a telegraphist, a secretary of the Director, a clerk, three store-keepers, or packers, and a messenger. In the department of lines, there are one visiting inspector general, and 18 inspectors of "zones," into which the system of the lines is divided. These inspectors superintend the maintenance of the 600 miles, approximately, contained in each district, or zone, the work being carried on by gangs composed of foremen and laborers. Besides the office of the administration, there are in the capital two telegraph offices; the "central,"



CENTRAL OFFICE, GOVERNMENT TELEGRAPHS, MEXICO.

for public and official traffic, and the private office of the President of the Republic, for his use exclusively. The staff of the first is as follows: A chief, a bookkeeper, three assistants, a superintendent of instruments, eighteen first-class operators, seven second-class, and eight third-class operators; one chief of distribution, reception, and copying of messages, with one assistant and two clerks; one counter clerk, with an assistant and fourteen messengers;

one batteryman ; a chief janitor ; one foreman of linemen ; one doorman : five linemen, and two porters. The private office of the President has a chief operator, and an assistant.

The total number of offices established in the Republic is 306. In the junction offices, the chief operator has under him the necessary staff of operators and messengers, and linemen sufficient to patrol the portion of line accorded to the office. The simple way offices have an operator, a lineman, and a messenger. In the offices which handle a large traffic, a bookkeeper is added to the staff.

III.

The estimate for the telegraph department in the fiscal year, 1894–5 was as follows :

Head office and all branch offices (the offices of the Administration and all telegraph offices.)	$723,814.65
Maintenance of the 41,000 kil. (25,500 miles), of lines	198,000.00
Printing	9,826.15
Stores	20,000.00
Freight and miscellaneous expenses	18,359.20
Total	$970,000.00

The charges for messages, as already mentioned, are arranged according to the "zone" system. The point of origin of a message is considered as the centre of nine concentric circles. The price of each message of 10 words is 20 cents within the first zone or circle, 40 cents to any point in the second zone, and 60 cents from the said centre to all places within the third zone. In short, the price of each message of 10 words increases 20 cents for each zone up to the ninth, beyond which the price is $2 for every 10 words. When the message contains more than 10 words, the charge for each additional word is $\frac{1}{10}$th of the rate for the first ten words. Each office has a tariff map, on which are plotted nine circles, having the office as their common centre; a simple inspection of the map informs the sender at a glance in which zone the point of destination of his message falls, and the calculation of the rate is then an easy matter for him.

In the fiscal year 1893–4, the receipts from messages were as follows :

Public Messages	$510,896.98
Government messages subject to discount	12,064.35
Cash receipts	522,461.33
Nominal value of official messages (free)	587,634.01
Total value of messages transmitted	$1,110,095.34

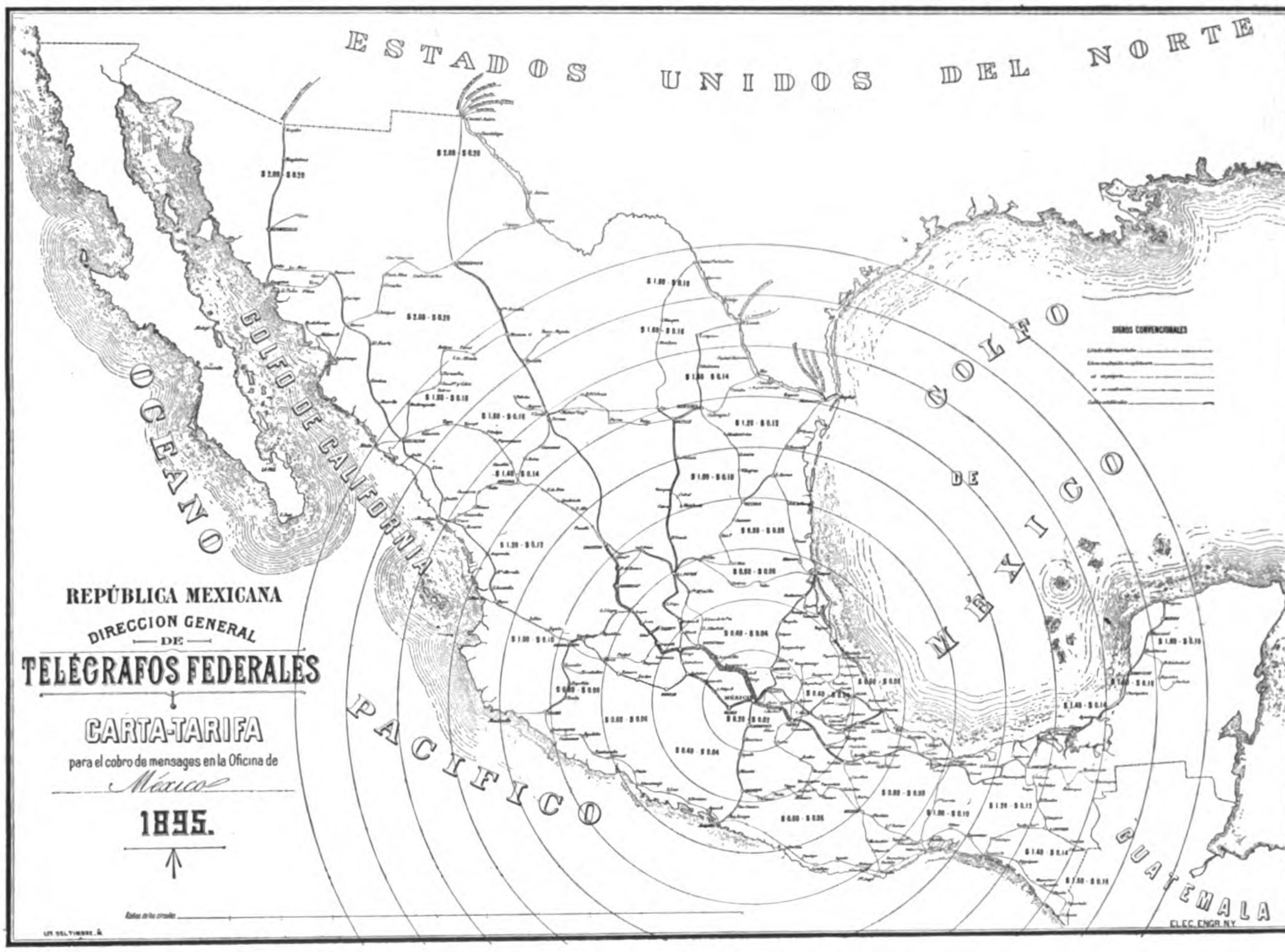
The Morse system is used throughout the Republic, and the instruments are all of American manufacture. There are duplex instruments in 20 offices, which are used when the excess of work makes them necessary. Twenty-five offices are equipped with Bunnell repeaters. Gravity batteries are used, with zincs of a special pattern devised by the Department.

The wire employed on the lines is of English make, No. 9 B. W. G. (4 mm.) The insulators are American, of glass, screwed on wooden pins. Wooden poles are used throughout, as a general rule of native growth.

The cables established up to date are :

	KILOM.
At Laguna de Terminos, between Jicalango and Laguna del Carmen	3.701
Between Puerto Real and Aguada	3.733
Across the River Papaloapan	0.300
At Coatzacoalcos	0.211
At el Grijalva	0.399

All the cables are of English manufacture.



MAP OF MEXICO, SHOWING THE ZONES OF TELEGRAPH RATES.

IV.

A resumé of the foregoing statistics shows that the wires of the Federal service at the present time run a length of 41,868 kilometres, or 26,016 miles. The number of poles in existing lines is 628,020; number of pounds of wire 8,373,600; number of insulator pins 628,020; number of insulators 628,020; number of offices open for service 306; number of office superintendents 306; number of operators 199; messengers and boys 273; linemen 362; inspectors 18; inspector general 1; employees of the administration (*i. e.* executive) 22; number of construction gangs, each composed, on an average, of a foreman and five laborers, 36.

It is instructive to compare the estimates for the fiscal year July 1885 to June 1886, and July 1893 to June 1894. The estimate of disbursement for the fiscal year of July 1885 to June 1886 amounted to $1,183,341.90.

The nominal receipts from messages in the same period were $600,180.14, distributed as follows:

Public messages	$150,160.59
Messages from the Governors of the States at half rate	5,024.43
Official messages free	444,995.12
Total	$600,180.14

The system existing in the fiscal year 1885–86 contained 9787 miles of line.

The estimate for the fiscal year July 1893 to June 1894 amounted to $1,050,000.00.

The nominal receipts from messages were $1,110,095.34, in the following form:

Public messages	$510,396.98
Messages from the Governors of States at half rate	12,064.35
Official messages free	587,634.01
Total	$1,110,095.34

The line system measured at the end of June, 1894, 24,856 miles of wire. At the present time it measures 26,016 miles of wires.

The estimate for the current fiscal year only amounts to $970,000.00, as shown in the paragraph treating of estimates.

V

The Federal Telegraph Buildings are pleasantly situated in the Calle Cinco de Mayo, in the heart of the city. The patio, which is almost covered by luxuriant tropical plants, has one side open to the street, from which it is separated by high rails. In the centre is a fountain, and the sound of falling water and the cool shade are grateful as one leaves behind the hot, white street. The buildings are divided into five sections, devoted, respectively, to the construction and maintenance of the lines, the service and personnel, stores and materials, accounts and auditing, and official records. In the central office there are forty operators, thirty on duty, and ten off. In the centre of the upper floor is the office of the Director General, a large, handsome and lofty room, which is full of interesting mementoes. Facing the entrance is an oil painting of President Diaz; on another wall is hung the portrait of Juan de la Granja, the founder of the telegraph in Mexico, in 1851. Over the entrance is a portrait of General Carlos Pacheco, the sturdy minister of public works, by whose zealous and powerful support, Mr. Islas was enabled to carry out his plans of reform. In a corner cabinet are various sending instruments, chiefly English and French, and nearby, prominently placed on a table, is a horseshoe with a history. On the day Mr. Islas went to the Palace to receive his appointment as Director-General of Telegraphs, he had an interview with the President, and on leaving, was stepping into his carriage, when he spied the horseshoe lying in the gutter. Accepting the lucky omen, he picked up the shoe, and it has never since left his table. Another interesting feature of the room is a photograph of Mr. Islas in the centre of a group of the officers of the service, presented to him by them in 1885, "testimonio de estimacion y respeto." The "esteem and respect," which thus found expression 10 years ago at the hands of his lieutenants, who knew him well, has now grown into a recognition throughout the country of the indebtedness of the public to the laborious, conscientious, and admirable work by which Mr. Islas has raised the Federal telegraph service to its present standard.

NON-MAGNETIC ELECTRIC DEVICES.

BY

Samuel Sheldon

I can hardly believe that Mr. Irish is sincere in his statement of belief that electro-magnetic devices will in the near future become mere museum relics. I would sooner believe that this fate awaits electro-thermal devices. If such devices are to supplant electro-magnetic ones, they must be at least equally as effective in operation; the competition will then depend upon cheapness and simplicity. In many cases an electro-magnet is too refined for the function which it has to perform; an electro-thermal device might well be substituted. In more cases electro-magnets are not sufficiently refined and thermal devices can never perform their functions.

Nearly all the devices mentioned by Mr. Irish depend in their operation upon the supposition that a conductor has a certain length for a certain current traversing it; a different, but definite, length for a different current. Now the length of such a conductor depends upon its temperature. The temperature is such that the rate of production of heat is equal to the rate of escape of heat by radiation, convection, and conduction. The rate of production depends upon but a single constant, resistance, other than the current. The rate of escape of heat depends upon the emissivity of the conductor, upon the size, shape, position, heat conductivity, and emissivity of the terminals, containing case, and neighboring objects. It is also dependent upon draughts and currents of air whether of constant or varying temperature. The emissivity of a body is a very uncertain quantity, varying much with the condition of polish or tarnish and with the temperature difference between the recipients of reciprocal radiations. Considering this fact and the uncertainty of the other conditions, it would be unwise to rely upon an accuracy of the ratio between the length and current within 5 per cent. Those who have tried to do accurate work with Cardew voltmeters are aware of this discrepancy. The peculiar manner in which the emissivity varies, together with the fact that the heat produced is proportional to the square of the current precludes the possibility of combining a wide range of action with even a passable proportionality throughout the range.

A thermal device cannot replace a magnetic one where responsiveness is requisite. This is shown in the case of fuses which require a time, expressed in seconds, to blow, while an electro-magnetic circuit breaker's inductance delays action by an interval expressed in hundredths or thousandths of a second.

ARMATURE CONDUCTORS.

Some years ago, Mr. Swinburne originated the statement that in the case of armatures with iron-embedded conductors, the driving force was borne directly by the iron instead of by the conductors, as in the case of smooth core machines. In a note on this subject appearing in the London *Electrician*, Mr. W. B. Sayers shows that this statement is substantially true for practical considerations, though not absolutely so.

ELECTRICAL THERMAL DEVICES.

BY

W. M. Stine

There are some electrical devices which from time to time have come prominently into consideration and as periodically been relinquished for more promising fields. Around such devices has lingered a halo of promise which so far has faded into disappointment. Incidentally the unipolar dynamo, the storage battery and "hot wire" apparatus may be presented in evidence. In each case the prime considerations have been well founded, but in their practical application so many modifying and antagonistic phenomena are associated, that results so far cannot be regarded as reasonably satisfactory. Long before the discovery and development of the electro-magnet, by Oersted, Ampere, Sturgeon and others, the heating power of the electrical current on the wire conveying it was known and experimented upon. In spite of this fact, its value as a factor in apparatus design has received but little attention, except in recent years. Ostensibly this would indicate that the electrically heated wire possessed but few points of value in practical application; and where a hot wire or electro-magnet are susceptible of being interchanged in apparatus design, the universal preference for the electro-magnet shows their relative value.

It should be borne in mind that a heated wire acts in a sense like a spring which may be expanded and contracted by the heating power of an electrical current. On the other hand, an electro-magnet acts in many cases as an ether stress spring, and, being practically massless must always be greatly superior to a material spring. The faults of the electro-magnet are hysteresis, residual magnetism, etc.; of the hot wire, sluggishness, drift, variation of constants, etc. The hot wire acts by virtue of the $C^2 R$ loss in it and primarily absorbs power; the electro-magnet acts in proportion to its ampere-turns, and only incidentally absorbs power. Though the hot wire is in general an inferior device when compared with an electro-magnet, there are cases in which it can be used to advantage.

The Electrical Engineer for May 8, contains an article by Mr. W. E. Irish, in which he discusses at length the employment of hot wire devices. This article is a timely one and very interesting in that the author points out systematically a large number of cases in which this device can be employed. The article must certainly prove of great service to designers and inventors, though its author is too enthusiastically prejudiced in favor of the device he advocates. A further discussion of several of the applications indicated may be of interest.

Galvanometers:—For such instruments the hot wire principle offers advantages for limited uses. There are many places where the ordinary magnet-system galvanometers can not be employed; for instance, where there is considerable jarring or magnetic drift. Further, such instruments are by no means portable. The D'Arsonval type of galvanometer, though free from magnetic drift is still disturbed by jarring. The pivoted instruments of this type are exceedingly portable and can be almost universally employed, but they have the disadvantage of a low sensibility. Judging from some hot wire instruments designed by Professor Ayrton and Mr. Willyoung it seems reasonable to suggest that this form of apparatus could be developed into a fairly sensitive galvanometer for portable work in connection with resistance and other measurements and prove as useful as the D'Arsonval type. This same class of galvanometers fitted with a mirror to be used with a telescope or lamp and scale would prove very serviceable in many laboratories. Such a galvanometer would, however, be somewhat sluggish, though dead beat, but low in sensibility compared with the better types of galvanometers. The writer has in use a hot wire apparatus of the pivoted type whose figure of merit reduced to the ordinary rating is 10^{-4}. It is possible to construct such apparatus to be at least 1000 times as sensitive, which would make a serviceable galvanometer, especially since it would not be greatly affected by the jarring of the building, nor affected at all by magnetic disturbances. The faults of such a galvanometer would be the temperature disturbances to which they are liable and their inability to withstand careless handling.

Ammeters, Voltmeters, and Indicators.—The hot wire principle has been largely employed for this class of apparatus. They possess a number of advantages,—are extremely dead beat, not affected by magnetic disturbances, can be employed with any character of current and are simple in mechanism. They offer especial advantages for use with an alternating current. Since the instruments of the Cardew type were placed on the market, the modifications which appeared showed the subject was a favorite one with inventors. At present the type has wellnigh passed out of use. This is in itself significant and indicates that a heated wire possesses too grave faults to serve as the vital member of instruments of precision. These faults are indeed numerous and, so far, have been but imperfectly overcome. However, these shortcomings can be overcome and a hot wire instrument be constructed which shall be accurate and durable; but its complexity and cost place it at a disadvantage when compared with the similar and perfectly satisfactory apparatus of the permanent magnet type.

The drifting of the zero point of the hot wire types is a radical fault, though this can be obviated by suitable compensation. They possess another drift, however, which only becomes apparent after some use. They are necessarily constructed of very thin wires, from .003 to .008 inch diameter. These wires must be kept under relatively strong tension and so experience a physical drift due to extension or fatigue after having been frequently heated and cooled. This latter fault does not permit of adjustment and necessitates frequent recalibration of the scale. The thin wire renders them unsuitable to withstand even moderate use, for it is readily broken or damaged by jarring and entails the annoyance of frequent repairs. They are more liable to be burned out than many other types and consume at least ten times the power of first class instruments, though in most cases this would not prove a grave objection.

Summing up their merits and faults it will be seen that the latter greatly preponderate, and their limited use is well justified by experience. They have been so thoroughly investigated that they no longer afford a field which will repay the inventor for working. Experience has placed a well-founded verdict on them and it is not likely the type can ever come into general use. That they have been employed recently is due to the fact that there are so few suitable instruments for alternate current working. Some years since, the hot wire volt indicators were widely exploited, but together with the entire class of so-called indicators they are rapidly passing out of use. Electricians have at length realized that it is not sufficient to *indicate* voltage, it must be accurately measured.

Thermal Arc Lamps.—For such construction the thermal principle undoubtedly offers many advantages. When electro-magnets are used in an arc lamp they ordinarily play the part of starters and arresters of motion, while the carbons are fed by the action of gravity or a spring. As a result such arc lamps are always more or less intermittent in action. In a few cases electro-magnetic feeding of the carbons has been attempted but the results have been far from satisfactory. With the hot wire, however, the feeding is gradual and uniform. Such lamps show a curve which closely

approximates a straight line and is far superior to the curves taken from the electro magnetic lamps. On this basis it would seem that thermal control should be exclusively employed. That it is not, indicates that here too, there are radical faults. Thermal lamps usually operate for a time under laboratory conditions with perfect satisfaction. In use, however, they invariably break down. This is due to their liability to get out of order, and the effect of wide temperature variations. In a reasonably uniform temperature such lamps do well enough, but extreme heat or cold renders them unsatisfactory. Attempts have been made to compensate them for temperature changes, but so far their success has not been demonstrated. A satisfactory thermal lamp seems a possibility, and future inventive skill will no doubt evolve it.

Armour Institute, Chicago, Ill.

THE THEORY OF THE BOYNTON MULTIVOLT BATTERY.

BY

Wm. A. Anthony.

I see in your issue of May 15 a notice of a new battery consisting of three zinc-carbon elements in one cell. I cannot understand how such a battery can work without considerable waste from local action.

To illustrate, let the accompanying sketch represent

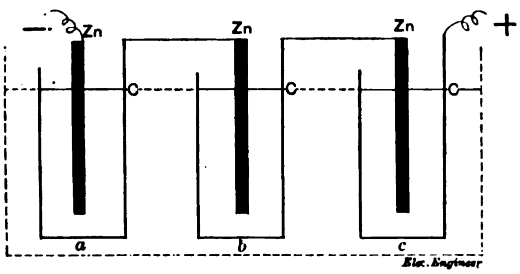


Diagram of Multivolt Battery.

three zinc-carbon elements and at first suppose the carbon to be cups to contain the exciting liquid. For convenience assume the E. M. F. of each cell to be 2 volts. It is evident that, when the cells are charged with the liquid and connected as shown, there will be a potential difference between the carbon cups *a* and *b* of 2 volts, the same between *b* and *c*, while a difference of 4 volts will exist between *a* and *c*. Now let the three cells be placed in a vessel, as shown by the dotted line, and surrounded by the exciting liquid. A current equal to this difference of potential divided by the resistance of the liquid, will flow from carbon to carbon.

In the description of the cell it is stated that the carbons are covered on the outside with rubber and that an opening is left in each on the side away from the other elements.

Supposing the outer surface of the carbon to be effectually insulated by the rubber covering, and I doubt if it could long remain so when immersed in the acid bichromate liquid, there is still an electrical connection through the openings between the inner surfaces of the carbons. These openings must be large enough to permit of the free circulation of the liquid, or the purpose of the apparatus is frustrated, and if they are large enough for this purpose, the resistance from carbon to carbon will be by no means large. The current that will flow through the liquid is, therefore, not negligible, and represents a constant waste wherever the zincs are immersed and connected.

But what is the use of it all? It would be very easy to make jars of such form that they would pack compactly in threes or fours and occupy but little more space for the same capacity than the single jar of this apparatus. This would prevent all waste currents and would produce a battery having all the advantages that the "multivolt" can have.

AMERICAN PRIORITY IN TELEGRAPHING WITHOUT WIRES.

BY

A. E. Dolbear

The increasing interest in the attempts to telegraph without wires both here and abroad makes it worth while to make mention of some facts which have been forgotten or ignored, and I venture to point out that the method which has lately been employed so successfully in England for telegraphing across a sheet of water between three and four miles wide with no connecting cable was fully described by Prof. John Trowbridge, of Harvard University, in 1880. He made his original researches between the Observatory in Cambridge and the City of Boston between which is a time signal wire having the circuit broken by clock once a second. He found he could hear the clock beats a mile away from the line by connecting a telephone to a wire five or six hundred feet long and grounding their ends parallel with the circuit.

His experiments and conclusions are detailed in a paper given before the American Academy of Arts and Sciences and are published in their *Proceedings* for 1880. How completely he covered this ground of doing telegraphic work by means of earth conduction will be seen by the following quotations from those Proceedings.

"The theoretical possibility of telegraphing across large bodies of water is evident from this survey which I have undertaken.

"Theoretically, however, it is possible to telegraph across the Atlantic Ocean without a cable. Powerful dynamo electric machines could be placed at some point in Nova Scotia, having one end of their circuit grounded near them and the other end grounded in Florida, the conducting wire consisting of a wire of great conductivity and being carefully insulated from the earth except at the two grounds. By exploring the Coast of France, two points on two surfaces not at the same potential could be found and by means of a telephone of low resistance the Morse signals sent from Nova Scotia to Florida would be heard in France."

This is precisely what is being done in England, carrying out Trowbridge's method. In the various descriptions of methods and operations which I have seen there is no mention of the work of Trowbridge and whatever merit and utility there may be in this method of doing telegraph work belongs to him. Shortly after the publication of the paper from which I have quoted, Dr. Edward Everett Hale, wrote a short story for the *Atlantic Monthly* in which these earth sheet currents played an important part. Beyond that I have never seen mention of the discovery, for it was a discovery and an important one too, that slight currents could be detected at relatively great distances from their source by means of a telephone connected to the ground.

THE HYDROGEN WALL IN ELECTROLYSIS.

To obtain a greater efficiency in the reduction of the highly electro-positive metals, such as potassium, from aqueous solutions, Mr. L. Pyke, at the recent Royal Society Soirée showed the "hydrogen wall." He produces an amalgam of the metal under reduction by placing the mercury cathode in a porous vessel. The amalgam is in its richest condition at the top of the porous vessel, which is the part furthest removed from the liquid. The precise action of the device is said to be the prevention of the liberation of hydrogen at the electrolytic contact surface.

THE PYLE ELECTRIC LOCOMOTIVE HEADLIGHT.

When the arc lamp had developed into a practical, commercial piece of apparatus, one of its uses early suggested was as a headlight for locomotives. But the trying conditions under which an arc lamp is placed, at the head of a locomotive, made it by no means an easy task to design a suitable electric headlight; and to this difficulty was added the reluctance of railroad companies and master mechanics to load on the already overburdened locomotive more apparatus in the shape of the engine and dynamo necessary to generate current. The problem therefore was by no means an easy one, but after a long period of study and experiment Mr. George C. Pyle, of Indianapolis, Ind., has succeeded in producing a locomotive headlight which seems to fulfill all the demands of practice.

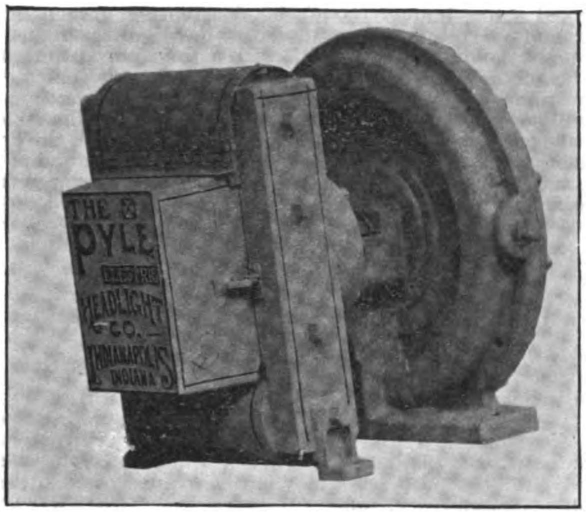


Fig. 1.—Pyle Headlight Dynamo and Engine.

Our illustration, Fig. 2 shows a locomotive of the Vandalia line, equipped with one of the Pyle electric head-lights, which has been in daily operation for the last six weeks. The little combined engine and dynamo will be seen directly behind the headlight, being about half the size of the headlight box; and Fig. 1 shows the combination in an enlarged view. Half a turn of a half inch valve passes enough steam to successfully run the engine, which is a compound steam turbine, and it makes no difference whether dry or wet steam is used, or whether a full head of high pressure steam is suddenly turned on, as there is no back lash or reaction. The weight of the armature shaft and turbine wheel is but 40 pounds. The bearings are 3⅛ diameter by 6½ inches long, which insures long life. The engine responds quickly when steam is turned on and the light is steady, powerful, and reliable. The electrical balance of the dynamo is so perfect that not the faintest spark can be seen at the brushes, not even when the locomotive is running at a rapid rate of speed, when the tendency is for the brushes to leave the commutator owing to the jar and rapid vibration.

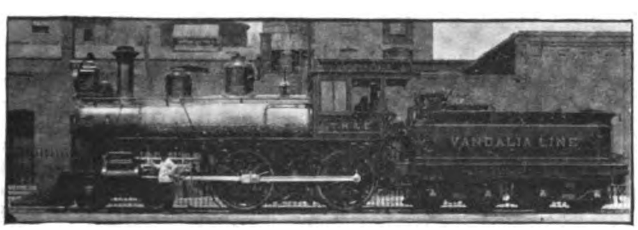


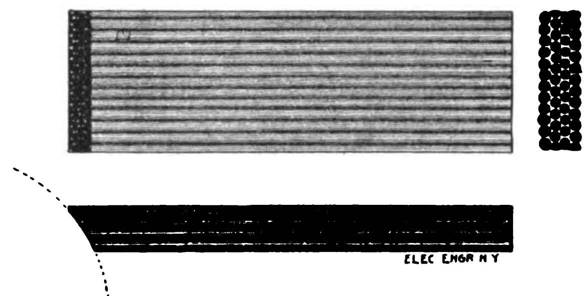
Fig. 2.—Vandalia Locomotive with Pyle Headlight.

MATERIAL WANTED FOR LIGHTING PLANT AT EVERETT, PA.

Application is about to be made for charter, etc., for an electric light plant at Everett, Pa. Permission for right of way, etc., has been granted by the town to Percy L. Williams, the leading spirit of the enterprise. All contracts for material are open except the wiring and line work, which have been given to Williams & Williams, of Middletown, Conn. Water will be the motive power. Inquiries should be addressed to Mr. Williams at Everett.

PROF. THOMSON'S CARBON BRUSH FOR LOW POTENTIAL MACHINES.

While carbon brushes have proved eminently successful for high potential machines, they have not been shown to be so satisfactory for the ordinary low potentials of 110 volts and under. This of course is largely due to the heat generated in the carbons by the heavy currents and the additional pressure required to get a good contact. One of the methods of overcoming this difficulty, employed in the past, has been to mix with the carbon a more or or less conducting material. Recently, however, Prof. Elihu Thomson has devised another method which will be readily understood by reference to the accompanying illustrations. Instead of employing a solid block, use is made of a number of small rods of carbon plated with a thin film of copper. These rods are assembled in the form required and of the required size so as to give the desired thickness, length and width of the brush, and the copper plated carbon pieces are united by soldering, that is, by "sweating in" solder between them in a sufficient number of places to hold them together.



Elihu Thomson's Carbon Brush.

The carbon surface applied to the commutator is broken away into facets, and the current which is taken from the commutator through the carbon faces is at once delivered to the metal which unites the various carbon pieces and is conducted through the body of the brush by the metal chiefly. The metal is so thin that the moment it touches the commutator at any point, the extra conductivity causes it to shunt enough current to disintegrate it at once, so that at all times the carbon surfaces take the wear and the metal is eaten away a short distance as rapidly as the carbon is presented.

This method of construction also permits of the conductivity of the brush being varied to suit the current to be taken up, and the potential of the dynamo will determine the amount of the metal which is to be used relatively to the carbon; that is, by plating the pieces more heavily the conductivity can be raised between limits, and by putting the merest film of metal on the carbon pieces, it can be lowered.

ILLUMINATING MEN-OF-WAR AT KIEL.

The Navy Department has arranged for spectacular displays by the American war ships at Kiel, which can hardly fail to create a sensation. Admiral Kirkland's four ships will be especially well equipped for displays at night. Each is provided with two or more powerful search lights, and each will be resplendent with thousands of incandescent lights. As a special decoration, each will carry before and around the pilot house an immense shield representing the American coat of arms, the red and white bars and the stars on a blue background being reproduced by electric lamps. The name of each ship will be brilliantly displayed in large electric letters running around the stern. In addition to these two special features, incandescent lights will be strung along each vessel's stem and stern from the water to the deck, and along the deck-rail from end to end, on both sides. Lights will be placed along the water-line on each side, just high enough to be out of the swash, thus outlining the hull. More lights will be strung up the masts and down the side stays, and and up and down and around the tops of the smokestacks. The lights will be set three feet apart, and at a distance will appear to be unbroken lines. There will be about 2,000 of these electric lights on the "New York" and about 1,500 on each of the other three ships. The finest display on the vessels will be the electric shield, which will be sixteen feet high and extend back on each side of the pilot house twenty-four feet.

Mr. W. G. Bond, for a number of years on the editorial staff of the London *Electrician*, has now undertaken the chief editorship of our excellent contemporary, and we extend to him our congratulations on his well merited preferment.

THE STEINMETZ POLYCYCLIC SYSTEM.

Following close upon his Monocyclic system of alternating distribution, Mr. C. P. Steinmetz, of the General Electric Co., has evolved another which he terms a "Polycyclic" system, specially designed to avoid unbalancing of the system when motors and lights are both supplied from the same circuits. The principle underlying the system will be clear on an inspection of the accompanying diagram, Fig. 1. Here a main generator G has a

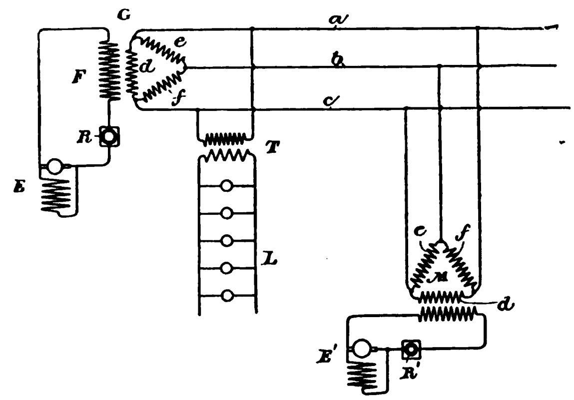


FIG. 1.—STEINMETZ POLYCYCLIC SYSTEM.

field-winding F supplied with current by a direct current exciter E. The armature of the generator G has a three-phase winding shown as comprising three coils connected in delta. A lighting circuit L is shown connected across the mains a c through a tension-reducing transformer T. A three-phase motor M wound in a manner resembling the generator, has its armature terminals connected to the mains a b c.

The novelty of this system, as thus far described, consists in massing the lights or other purely single-phase translating devices requiring constant potential on one branch of the system, and transferring energy between this branch and the other branches through one of the motors coils. Assuming for example that in a given installation the lamp load is to be one-third of the motor load, then the d coils of the motor and generator or the resistance and self induction of the connecting mains will ordinarily be such that at normal load, substantially no energy current flows through the coil d of the motor between the mains a c. The lamps then form the normal load on this branch, and receive currents of one phase, while the motors receive power currents of two phases between the other branches of the system b c and a b. There will then be substantially a balance between the counter electromotive force generated in the circuit of the d motor coil and the impressed electromotive force in the lighting circuit. Whenever this relation becomes disturbed, as for example, by changing the lamp load and so changing the voltage in the lighting circuit, the balance is restored by current flowing through the d coil of the motor and which may help out either the lamps or motors, as conditions require. The e and f coils of the motor have a less number of turns than the corresponding coils of the generator, so as to normally receive power currents.

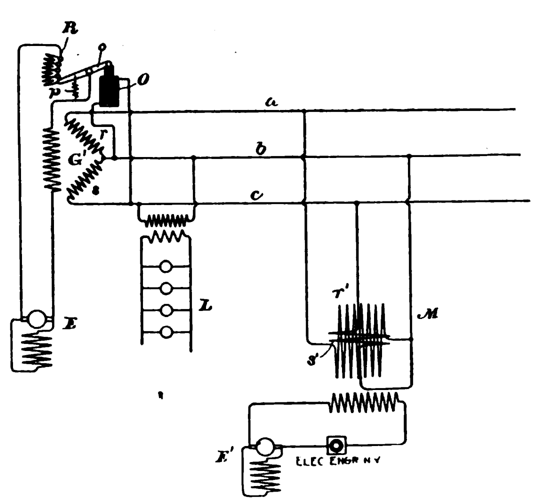


FIG. 2.—STEINMETZ POLYCYCLIC SYSTEM.

In Fig. 2 a quarter-phase generator G′ is illustrated, whose field is excited as in Fig. 1 by a direct current machine E. The armature of the generator has coils r s disposed ninety degrees in the field of force and connected to the circuit mains a b c in the manner indicated, the main b being a common return for the two branches of the system. The lighting circuit L is coupled across the mains b c and motors or other motive apparatus such as rotary transformers or phase-controllers have coils connected across the different branches of the system. As shown at M, which represents a synchronous motor, there is a main coil r' connected across branch a b of the distributing system, and a supplementary coil s' connected across the lighting mains b c. The field of the motor is in circuit with a direct current machine E′. This motor operates after the manner of a monocyclic motor. Under ordinary conditions the principal part of its operating current will be derived only from the motor branch of the system, while the current supplied to the lamps is derived from the lighting mains. The system is thus divided into lighting and power work, and the balance is maintained by transferring energy from one branch to the other through the balance wire and supplementary motor coil s'. The proportions of the machines will ordinarily depend upon the conditions in any given installation.

LETTERS TO THE EDITOR.

THERMAL WIRE AS AN ARC LIGHT MACHINE REGULATOR.

THE article of Mr. Irish's in your issue of May 8 recalls some attempts made by the writer to utilize a thermal wire in place of the electromagnet. I even went so far as to apply for a patent on the device in 1889. This consisted of a fine strip of metal which was used for the purpose of moving the brushes of an arc light machine. The patent was allowed and the scheme was thoroughly tried on a Fuller-Wood machine. I became so disgusted, however, with the sluggish and freaky performance of this regulator that I did not even wish to spend the final government fee on the patent. I gladly give the idea to the world. Maybe some one can improve on it.

I wish to compliment Mr. Irish upon the thoroughness with which he has treated the subject, although in many cases, the results of my own practice do not coincide with his views. Briefly stated, I have generally found heat to be too slow.

ROBERT LUNDELL.

ELECTRO-THERMAL DEVICES IN PRACTICE.

In your issue of May 8 appears an article by Mr. W. E. Irish upon non-magnetic electric devices in which a number of devices depending upon the heating of a strip by the current are illustrated diagrammatically, and in the fact that such devices will work, the author sees a promise of a complete revolution in the construction of electrical instruments. As he makes no attempt to show the details of construction or the proportion of parts, it is impossible to judge how well a device would work. On general principles I should expect an electromagnetic instrument to work very much more promptly than one actuated by the expansion and contraction of a metal strip. Expansion results from change of temperature, and change of temperature requires time. How much time, depends upon the mass of metal to be heated, the amount of cooling surface, the amount of current, etc. One would like to know how thin a strip and what amount of current is necessary to work the telegraph sounder, Fig. 10, at the rate of forty words a minute.

There is no doubt that instruments in which time is no object can be worked by the heat generated by the current; there is no doubt either that by the use of very thin wires or strips presenting large surfaces and using comparatively heavy currents, instruments may be made to respond quickly, but how do such instruments compare in force and amount of motion, strength of current used, etc., with electro magnetic instruments? A Cardew voltmeter will require .5 ampere where a Weston voltmeter would require only .01 ampere.

As an illustration of the time element, small safety fuses serve a satisfactory purpose, because they are quickly melted by the flow of an abnormal current, but large fuses that must normally carry heavy currents are so sluggish in their action as to be practically useless, and electro-magnetic circuit breakers are substituted for them.

But what has Mr. Irish shown us that is new? Several of the devices that he describes have been on the market or have been exhibited in practical form. Hot wire voltmeters and ammeters are on the market; regulators using hot wires have been suggested. If I remember rightly Edison exhibited at the Paris Exposition in 1881 a telegraph relay acting by the heating and cooling of a platinum wire. But electro-magnetic devices are not yet "relics of the past." How has Mr. Irish overcome the difficulties that other inventors have met with? Information along this line would interest us more than the mere diagrammatic illustration of the way a thing could be done. We knew that already. The question is can it be done practically, and how?

WM. A. ANTHONY.

A MEMORIAL ATLANTIC CABLE PICTURE GIVEN TO THE NEW YORK CHAMBER OF COMMERCE.

On May 28, about 850 members of the New York Chamber of Commerce, with a number of ladies, attended a special meeting of that body at 3 o'clock p. m. in the handsome and stately audience hall to witness the ceremony of the presentation to the Chamber of the picture commemorative of the work of the late Cyrus W. Field and his associates in laying the first cable under the Atlantic Ocean. Alexander E. Orr presided and George Wilson occupied his usual place as secretary. Among electrical representatives present by invitation were leading officials of the Western Union Co.; G. G. Ward, vice-president of the Commercial Cable Co.; Dr. S. S. Wheeler; T. C. Martin.

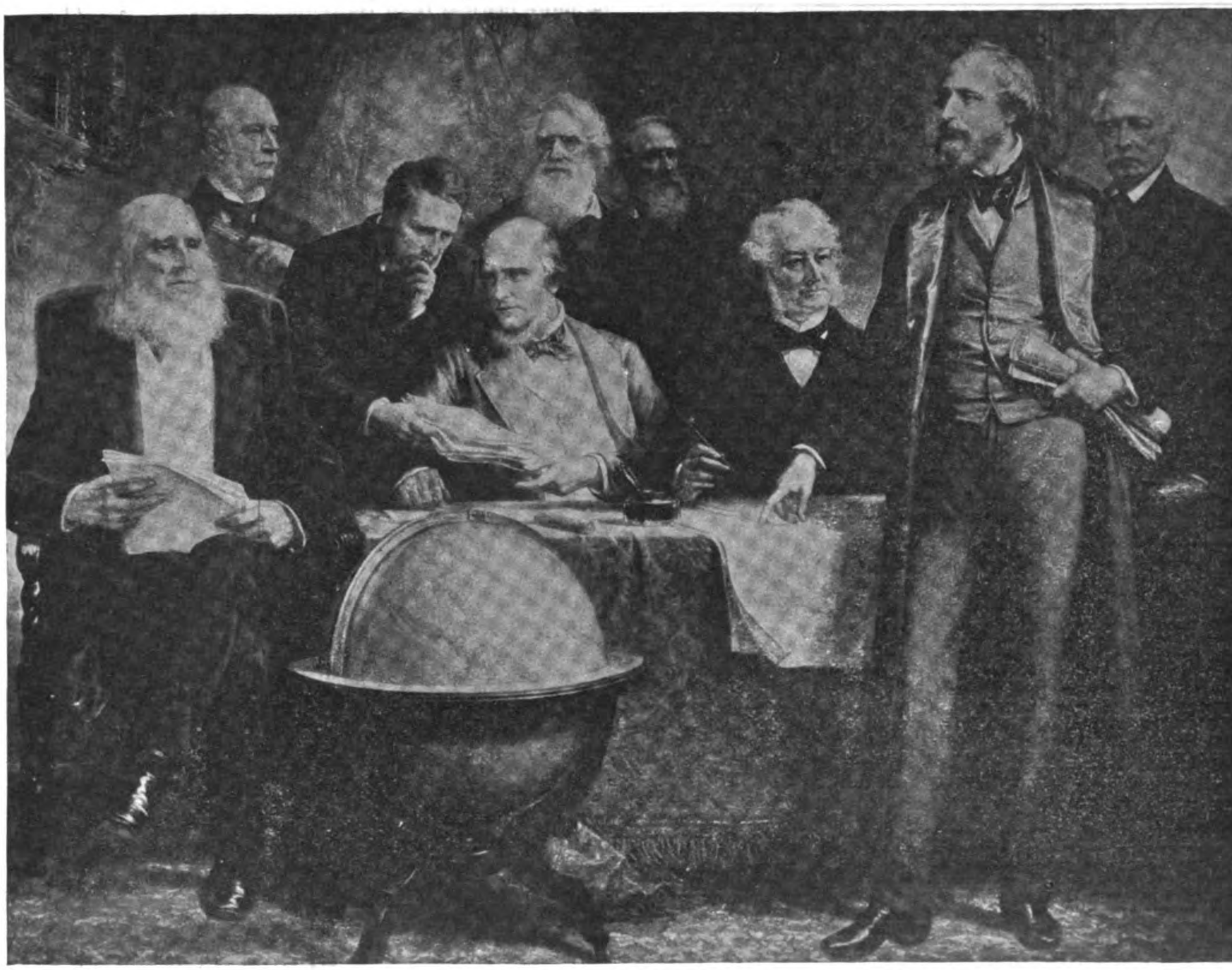
The presentation of the picture was made by Morris K. Jesup, one of the Vice-Presidents of the Chamber and chairman of the committee appointed to secure the memorial; his associates being Abram S. Hewitt and W. E. Dodge.

At the conclusion of a brief and admirable address, Mr. Jesup read letters from Justice Stephen J. Field of the United States Supreme Court, brother of the late Cyrus W. Field, acknowledging the Chamber's invitation to attend the presentation; and Daniel Huntington, the latter stating that the first thought of painting such a picture came to him from Mr. Field himself, who called at his studio after the final and complete success of the cable of 1866, and consulted him about painting such a group as the one depicted on the canvas. Mr. Huntington said he went with Mr. Field to his house in Gramercy Square, and with Mr. Peter Cooper, who came and took the chair, as he was accustomed to preside. Mr. Field stood by the table, with charts and globe at hand, as he usually stood when explaining his plans, and Mr. Huntington then made sketches for the proposed picture.

This was followed by a charming oration from Mr. Chauncey M. Depew, who told once more in simple but vivid language the ever thrilling story of the discouragements, disasters and final success with the first cable. President Orr then accepted the picture in behalf of the Chamber, with suggestive comment on the close union between commerce and science.

The picture thus added to the valuable collection possessed by the Chamber of Commerce represents a meeting of the Atlantic-cable projectors at the residence of Mr. Cyrus W. Field in Gramercy Park. Mr. Peter Cooper is presiding. Mr. Field is calling attention to a chart of Trinity Bay, pointing to Heart's Content as a safe harbor for landing the cable. Mr. David Dudley Field stands by the president with a law-book. Mr. Chandler White is handing estimates of expense to Mr. Marshall O. Roberts, next to whom, at the table, is Mr. Moses Taylor, listening to Mr. Field's argument. Near Mr. Taylor, at the end of the table, stands Mr. Wilson G. Hunt, who, though he joined them some time after their first organization, remained a stanch supporter of the project to the end. Prof. Samuel F. B. Morse is standing behind Mr. Roberts, and by his side is the artist, Mr. Huntington, sketching. The picture is life size, the canvass being 9 feet long by 7 feet in height, with a rich and appropriate frame. The list of donors includes the estates of Peter Cooper and W. G. Hunt; the Gould brothers; the Western Union Co.; the Dodge family; Cornelius Vanderbilt, J. P. Morgan, and about fifty others.

David Dudley Field. *Chandler White.* *Prof. Morse.* *Daniel Huntington.* *Wilson G. Hunt.*



Peter Cooper. *Marshall O. Roberts.* *Moses Taylor.* *Cyrus Field.*

MEMORIAL PICTURE OF ATLANTIC CABLE PIONEERS, PRESENTED TO THE NEW YORK CHAMBER OF COMMERCE.

THE HISTORY OF THE FRANKLIN INSTITUTE.

The Franklin Institute, which has achieved for itself an name enviable all over the world, and has aided materially by its scientific work in placing Philadelphia in the lead as one of the great industrial cities of the world, has published a sketch of its organization and its history from 1824 to 1894. The interest of the pamphlet is increased by the movement now on foot for the construction of a new building for the Institute of which mention was made in these columns recently.

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CONTENTS.

BUFFALO BLINDNESS.

THE resolve of the American Institute of Electrical Engineers to hold its meeting at Niagara on June 25, again directs attention to the great power transmission enterprise there, about which so many articles have already appeared in our pages. It is a curious anomaly, however, that although the Engineers, several hundred strong, are going to the Falls to see this remarkable plant, designed for transmission work, the city of Buffalo through some strange twist of politics or sentiment, is actually in the position of barring out the power which the plant would deliver to it. Indeed, the situation may be more critical than Buffalonians assume, for apparently as fast as a new generator gets into place, a local consumer of the power starts up at Niagara; so that presently we may see the strange spectacle of a great city at the Falls, with Buffalo as an annex in which the motive energy is so much dearer that every consumer who can leaves it in order to get nearer the great Cataract. Buffalo may yet be playing to Niagara Falls the part that Brooklyn plays to New York city. A recapitulation of the facts in such an extraordinary situation as the present will not, perhaps, be amiss.

In 1894 the Niagara Falls Power Co. applied to the Common Council of the city of Buffalo for a franchise giving it the right to distribute its power in that city. It had already practically secured its right of way from Niagara to Buffalo and had ordered three 5,000 horse power dynamos with a view to transmitting 10,000 H. P. of their product for use in the city of Buffalo. Subsequently, and quickly, a large portion of the product of these dynamos was leased by the company for local use on its lands at Niagara. To supply 10,000 H. P. to Buffalo now would require an extension of the present wheel-pit and the installation of three additional 5,000 H. P. turbines and three additional 5,000 H. P. dynamos. Such additional installation, however, could be made in eight months from the time the order was given and it would probably take eight months for the city of Buffalo to get ready for the distribution.

On February 21st, 1895 (just three months ago), the Power Company at the request of the Common Council submitted a statement of its position in regard to power for use in Buffalo. The company remarked that two restrictions incorporated in the proposed franchise would absolutely prevent its acceptance by the company,—one of them being a time limit less than the term of its bonds, and the other being the fixing of a maximum or other price for power in the city. In this same statement, the company met the suggestion that the city itself purchase the power from Niagara, by offering to sell power, to the city in blocks of 10,000 H. P. delivered at Niagara, either as "undeveloped" power, "developed" power or "electrical" power, at the low prices of $10, $13, and $18 per H. P. per annum, respectively. This was to enable the city to exercise entire municipal control of the power in Buffalo. This statement also contained some figures as to the cost of steam power in Buffalo, which were obtained from actual expert tests.

Nothing has been heard by the company in reply to this statement,—we are informed—and it now appears that after three months' delay the Common Council is about ready to recommend a franchise, the text of which as printed recently in the Buffalo papers, seems to contain the two restrictions which will absolutely prevent its

acceptance by the company if the company stands on its original statement. It contains other restrictions which seem to us both onerous and unreasonable. It is only necessary to mention two of the conditions: One is that the company shall supply the city with electric power for the operation of its water works, requiring 4,000 H. P. at $20 per H. P. per annum; and the other is that it shall supply electricity so that the General Electric Co. of Buffalo, which has the contract for municipal street lighting in that city, shall be able to furnish arc lights at $50 per H. P. per annum. It must be obvious to anyone familiar with the cost of electrical power and electric lighting, that these two restrictions amount to compelling the Power Company to give to the city 4,000 H. P. for its water works at one-third of the cost of the steam power now operating their City Water Works plant and at less than the present cost of electrical horse power at Niagara; and, further, to supply to the General Electric Co. of Buffalo about 3,500 electrical horse power without charge. It is a well-known fact that if the mechanical power were given to the Buffalo General Electric Co. by the Niagara Falls Power Co. free of charge, the local lighting company could not at cost furnish arc lamps at $50 per H. P. per annum. The supply of carbons and the attendance alone upon each arc lamp is well known to be about $25 per arc lamp per annum, and an arc lamp is practically equal to a horse power.

These restrictions seem to be absolutely prohibitory, and it must be ignorance on the part of Buffalo's officials which considers for a moment the introduction of such provisions in the franchise. It cannot be supposed for a moment that the city of Buffalo under-values the advantages of the introduction of Niagara power, about which it has boasted for so many years and on account of which it has assumed to itself the sounding title of the "Electric City."

Recent tests of the cost of steam power in Buffalo, made since the publication of the printed statement of the Power Co.,—and by so competent an expert as Mr. Horatio A. Foster,—show that for small plants, such as newspaper and printing plants, where the amount of horse power in use varies from 20 to 150 H. P. the cost of the steam horse power per annum varies from not less than $110 up to as high as $160 per H. P. per annum; while no large plant in the city of Buffalo can be found using 1,000 H. P. or more where the cost of the steam power is less than $50 per H. P. per annum. It appears, however, that the Power Co. is willing to go to the large expenditure necessary to introduce Niagara power in the city of Buffalo. It is certain that the company cannot sell that power unless it can be used at a cost below that of steam power, yet Buffalo does not seem to be willing to have the company, at its own cost, free of charge to the city, put Niagara electric power on sale in the city of Buffalo!

The action of the city has given the impression to some people not familiar with the successful transmissions of electric power for greater distances than that between Niagara and Buffalo that there is some question about the practicability of this transmission. The fact that the Niagara Company is ready to install the plant would be sufficient answer to this suggestion; but those who know of the Frankfort-Lauffen transmission of 108 miles, and the more recent successful operation of the various plants in this country, such as at Telluride, Sacramento and other places where the distance exceeds 20 miles, (as well as the Tivoli-Rome installation) recognize in this situation no reason for doubt of the entire success of the Niagara transmission to even greater distances. It is an instance of remarkable blindness to its own interests, on the part of a city which has in other matters shown unusual indications of enterprise and successful growth. But is the whole of Buffalo blind? We simply refuse to believe that the people, interested in the future of a city which some day might rival Chicago, will thus be committed to a false line of action on a question so momentous.

THE COLD "SNAP".

The swift descent upon us of cold weather, with casual snow flurries and brittle ice, was a surprise after the 90° weather of earlier May; but this is a change that happens nearly every year. It is supposed that the joke is on the man who has started up his electric fans; and one of our Chicago advertisers uses the point to make a clever volte-face. But the truth is that such "snaps" and "spells" are only another argument for electricity. When the ordinary heating system of a house, hotel or office building is shut down, it is very often a difficult thing to put it in operation again; and many leases set a date beyond which the landlord is not responsible for heat. This is more awkward and inconvenient where the tenant has no open fire place, by means of which to eke out his natural warmth; and we have known of instances of sickness when this has been serious. The little gas and oil stoves are a boon, but they are the most unconscionable foes of a pure atmosphere that were ever created.

Now it is just here that the electric heater gets in its work. It may not yet be the altogether economical consumer of energy it is destined to be, but as a converter of that energy it is already high in the scale of efficiency. But the point is that a man who has electric current at command, need not worry about cold snaps or hot waves, for he can meet either with equal facility, whether the thermometer rise, or fall, 25 degrees in an hour or two. A little electric heater will warm up a room wonderfully and a little fan motor will cool it with no less celerity; while each can be moved around as easily as a cup or chair. In the Spring and Fall of the year there are many treacherous days, but armed with his electric heater and fan the modern man can fight off all the insidious ills that would assail him. Central stations can increase their income, and supply men their trade, by teaching this beautiful, true and simple doctrine.

STREET CAR SPEEDS.

As was to be expected, many citizens of Brooklyn are now annoyed at the slow speed of the street cars, and want them faster; while, on the other hand, the agitators responsible for the regulations say they can get 200,000 petitioners in favor of the lower speed. It seems to us that the whole case is on a wrong basis, and we venture to take the following little item as a text:

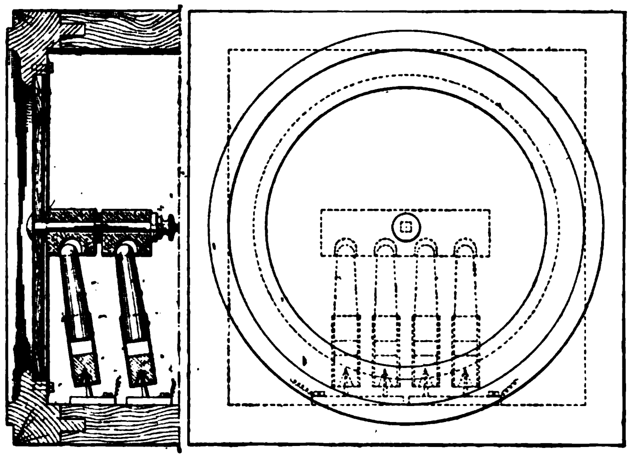
> A cable car was rapidly going west in 125th street about eleven o'clock last night when two wheelmen, Charles Ransom, of No. 872 Alexander Avenue, and Walter Rogers, of No. 481 East 125th street, tried to get before it at Manhattan avenue. Ransom succeeded, but as Rogers reached the track some obstacle pierced his bicycle's pneumatic tire, the result being that he was thrown from the wheel. He fell in the middle of the track, but the gripman saw him in time to bring his car to a standstill *a foot away from the young man's head.* Rogers, who was stunned, was carried into a neighboring drug store, and a doctor who was summoned found that his nose was broken and his scalp badly lacerated, and it was thought he was injured internally. He would not hear of going to a hospital, however, so his friend called a carriage and in that he was taken home.

Now, it is well known that these cable cars are equipped with the Genett air brake—and not the later, better form of it, either. If Brooklyn will only insist on its trolley cars having such a brake, its modern citizens can have cars just as fast as they need them and its 200,000 sleepy antiquated citizens who have hitherto objected, can still stay on the track as long as they like, with impunity. The air brake on all street car lines is as inevitable as it has proved to be on steam railroads, and we have no doubt that within a very few years, every car in every city will have it, either adopted voluntarily or enforced by legislation.

TELEPHONY.

THE MERCADIER AND ANIZAN MICROPHONE.

M. E. MERCADIER, of Paris, well known for his telegraphic and telephonic researches, together with M. J. M. Anizan, whom many electrical visitors will recall in connection with the French Electrical Exhibit at Chicago, have designed a form of microphone transmitter which is claimed to avoid a number of difficulties attending the present types of transmitters with solid electrodes. In the form of microphone designed by these engineers, the vibrating

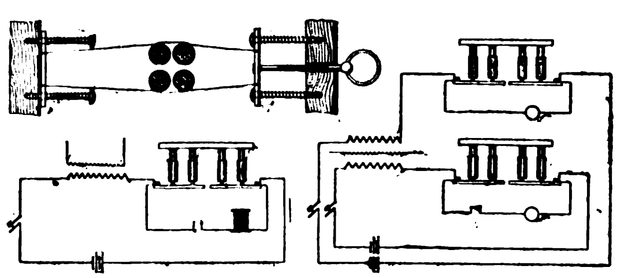


FIGS. 1 AND 2.—THE MERCADIER-ANIZAN MICROPHONE.

plate, as shown in the engravings, Figs. 1 and 2, carries one or more carbon strips having concave recesses on their under sides. The other electrodes consist of a number of carbon pencils mounted in brass tubes and having their lower ends closed by plugs of brass which have conical cavities.

The carbons are supported by points so placed that the upper ends of the carbon pencils bear against recesses in the lower sides of the carbon strips attached to the transmitter disc. By this construction, the carbon pencils are rendered easily movable and are sensitive in adjustment, at the same time allowing the position of the contact points to be changed at will. In order to effect the latter purpose the inventors employ a simple device, which is illustrated in Fig. 3. This consists of a cross-piece to which silk threads are attached which pass around the carbon and which are slack when at rest. When these strings are pulled tight they carry the carbons slightly along in their motion, and, when released, the carbon pencils revolve in the reverse direction. Numerous experiments have shown that this reverse action of the pencils is more active than the first, so that they pass beyond the initial point of contact before coming to rest. The pressure between the carbon pencils and the carbon strips can of course be varied by sliding forward the base upon which their pivots are mounted, thus varying the angle of inclination.

In order to adapt the instrument for both local and long dis-



FIGS. 3, 4 AND 5.—THE MERCADIER-ANIZAN MICROPHONE.

tance work, the inventors introduce a shunt resistance, as shown in Fig. 4, in connection with the switch. For long distance work the sensitiveness of the microphone is made as great as possible by leaving the shunt open, while for local work the switch is closed and the resistance placed in shunt. When more than one strip is used in the same microphone, several primary induction coils can be employed with a common secondary; this arrangement is shown in Fig. 5.

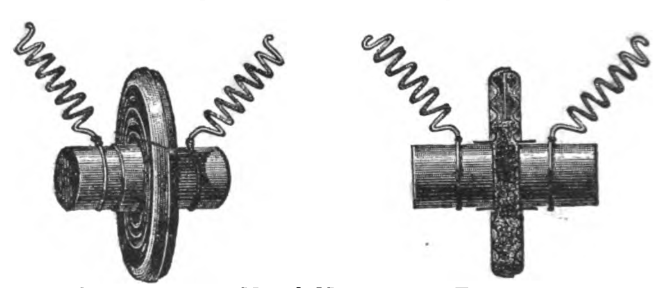
A COMPANY FORMED TO INTRODUCE THE MILDE TELEPHONE.

Details as to the new telephone company that has the exclusive privilege of using the Mildé microphone in the United States have been made public. The deal by which the new company absorbs the Standard Telephone and Electric Company of Wisconsin, and continues business under the same name in Madison, Wis., was completed in Madison, where the apparatus will now be made. The articles are signed by Madison people as incorporators. They are P. L. Spooner, B. B. Clarke and N. P. Bross. Among the other known stockholders are C. E. Bross, of Madison, and Dr. S. S. Kilvington, E. W. Batchelder and H. C. Dodge, of Minneapolis, all of whom were in the old company.

The articles fix the capital stock at $500,000, but it is said that aside from the names given to the public there are other wealthy men that are heavily interested financially in the new company. Among these is said to be Ex-Senator John C. Spooner, of Wisconsin. The promoters have made a careful investigation and have tested the instrument thoroughly between Madison and Milwaukee before entering into the negotiation. The officers are: President, P. L. Spooner, of Madison; vice-president, B. B. Clarke, of Madison; secretary, E. W. Batchelder, of Minneapolis; treasurer, R. M. Lamp, of Madison; electrician, H. C. Dodge, of Minneapolis.

The Mildé telephone was first brought prominently to notice in this country at the World's Fair, where an interesting exhibit was made under the direction of Mr. G. Pellissier, in behalf of C. Mildé Fils & Cie. of Paris. The display included several types of telephones comprising a complete equipment for local, interurban and domestic telephonic communication. The Mildé instruments have been largely employed in France for all the abovementioned purposes. In all the Mildé telephonic apparatus the transmitter is a microphone of the type shown in Figs. 1 and 2 which has been constructed with the object of allowing of the direct transmission of the sound waves without passing through the intermediary of an induction coil. The adoption of this principle appears to have been very fruitful of results, and to allow of installing telephone stations very economically. For instance, in a small domestic service or even in a city exchange, batteries situated at the exchange are able to furnish the necessary current, thus obviating the necessity of giving each subscriber a battery.

The Mildé microphone consists essentially of two short carbon



FIGS. 1 AND 2.—MILDÉ MICROPHONE TRANSMITTER.

cylinders inserted, respectively, in the two halves of a small metallic aneroid box, but insulated from them. The little box is filled to about five-sixths its height with carbon granules. One of the carbon cylinders is fixed to the vibrating diaphragm of wood and a neck or groove on each carbon cylinder serves for the attachment of the line wires; finally, the interior faces of the carbons are scored lightly in order to afford a better contact with the carbon granules.

When the transmitter is unhooked for service, a weak current passes, on account of the nature of the material employed. When the diaphragm is spoken to, however, the following action takes place. The air vibrations are taken up by the wooden diaphragm, which carries with it in its movement one of the carbons which is attached to it, as well as the metallic shell in which the latter is inserted, and there is a recoil. On account of the inertia, the back part of the box vibrates with less intensity than the front part; there results from this a microscopic flattening of the microphone box, and the current passes in greater strength to the line, with corresponding effect on the receiver at the other end.

The simplicity of this apparatus, the small dimensions of the telephone set, its power, the small cost at which it can be manufactured, and the facility with which it can be attached to existing call-bell wires for domestic work, have naturally led to its widespread adoption in Europe and especially in France. One form of the Mildé telephone receiver, like nearly all foreign receivers, is of the bipolar type, with bobbins wound on cores no larger than ⅜ inch long and $\frac{1}{16}$ inch in diameter. These cores are attached to an open steel ring having arms running to the centre so that the ends of the cores are presented to the centre of the diaphragm.

The firm also exhibited single pole telephones, and the com-

plete telephone set constructed specially for the French Government exchanges. In these an induction coil was included, in order to conform to the specifications of the French Administration of Posts and Telegraphs.

THE BERLINER PATENT.

SINCE the appearance of the editorial in our last issue on the Berliner patent just sustained by the U. S. Court of Appeals at Boston, we have received so many inquiries as to the exact scope and nature of the patent that we have deemed it of sufficient interest to publish below the complete specification drawings and claims :

UNITED STATES PATENT OFFICE.

EMILE BERLINER OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

COMBINED TELEGRAPH AND TELEPHONE.

Specification forming part of Letters Patent No. 463,569, *dated November* 17, 1891.

Application filed June 4, 1877.

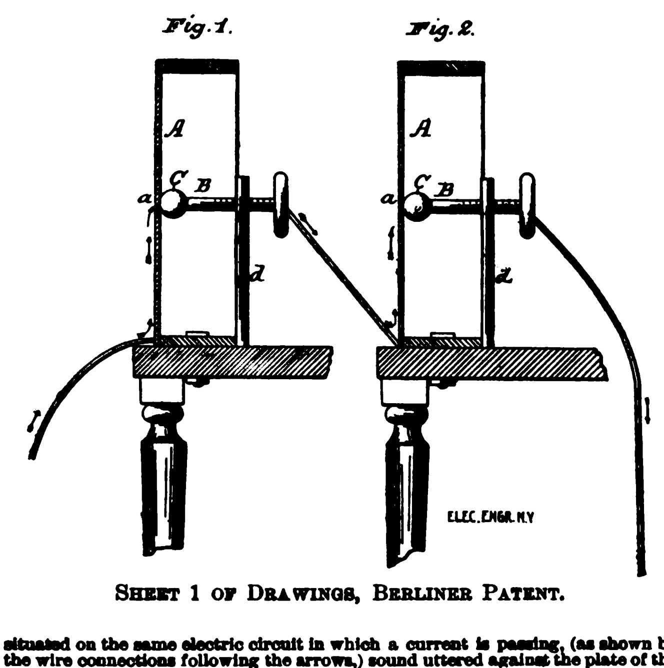
To all whom it may concern:

Be it known that I, EMILE BERLINER, of Washington, in the District of Columbia, have invented a new and useful Improvement in Combined Telegraph and Telephone, of which the following is a specification.

My invention consists in a new and useful improvement in transmitters for electrically transmitting sound of any kind, of which the following is a specification.

It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current the pressure between both sides of the contact becomes weakened the current passing becomes less intense—as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving-instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner.

In Figures 1 and 2 of the drawings, A is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball C, terminating the screw-threaded rod B, which is supported by the bar or stand *d*. The pressure of the ball C against the plate A can be regulated by turning the rod B. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate the pressure at the point of contact *a* becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station Fig. 1, and another instrument capable of acting as a telephonic receiver in the station Fig. 2, both



SHEET 1 OF DRAWINGS, BERLINER PATENT.

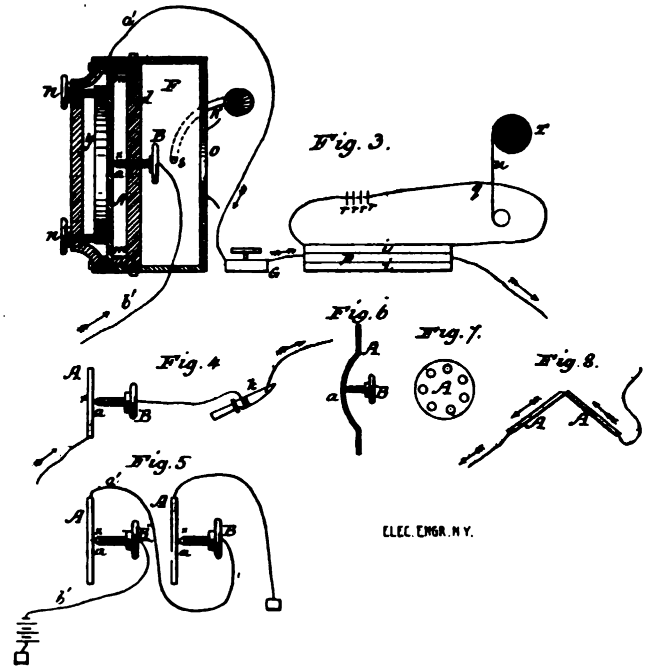
situated on the same electric circuit in which a current is passing, (as shown by the wire connections following the arrows,) sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2, for as the vibrations of the transmitter Fig. 1 caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter Fig. 1 will be reproduced at the receiver Fig. 2, or in as many other receiving-instruments as are situated within the same electric circuit.

It is not essential that the plate should be of metal. It can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, or other suitable vibration media may be used—a wire, for example. Any other metallic point, surface, wire, &c., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibrations. Both of the electrodes may vibrate, although it is preferable that only one should. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving-instrument will be a tone much louder, but not as distinct in regard to articulation.

I have also embodied my invention in and used it in connection with some other forms of apparatus.

In the drawings, Fig. 4 represents a detached view of the vibratory diaphragm, showing its relative situation to the poles of the galvanic current. Fig. 3 represents a view of a complete apparatus; Fig. 5, a view of the diaphragms arranged to receive and transmit the sound waves; and Figs. 6, 7, and 8 modifications of the vibratory diaphragm.

In the drawings, the letter A represents a diaphragm or plate of thin



SHEET 2 OF DRAWINGS, BERLINER PATENT.

metal, of limited conductive capacity, such as iron, steel, German silver platinum, secured in the frame *m m* in the box F in any convenient manner.

The letter *y* represents a ring resting against one side of said diaphragm and capable of being made to bear upon the same with more or less force by means of set-screws *n*, in order that the tension of the diaphragm may be regulated.

The letter B represents a screw or pin of metal, pointed at one end and mounted in a cross-piece *d* in such position that the point will be in contact with the diaphragm A. The diaphragm A is connected with one pole of a battery by means of a wire *a'*, and the pin or screw B with the other pole by means of a wire *b'*.

The box F of Fig. 3 is provided with a tube K, to which the ear of the operator may be applied, in order to hear the sounds produced by the vibratory diaphragm when the instrument is employed as a receiver, and a tube O, through which he can speak when employing the instrument as a transmitter, so that the operator is not in need of moving the instrument or moving his head while carrying on a conversation.

Instead of employing a single vibratory plate, as shown in Figs. 1, 2, 3, 4, and 5, in each instrument, two such plates may be employed, as illustrated in Fig. 8, said diaphragms being connected to the respective poles and in contact with each other at their edges, as shown in Fig. 8.

The diaphragm of my improved receiver or the diaphragm of any magneto-receiver (such as those described by Alexander Graham Bell in his Patent No. 174,465 of March 7, 1876, and in his Patent No. 186,787 of January 30, 1877) will receive a particularly strong shock at the setting in and sudden cessation of the current when a ticking sound will be heard from the plate; but a weakening of the current alone can also be observed most distinctly and accurately by making, for example, a connection within the same circuit by a wire and the blade of a knife *k*, Fig. 4. When scraping the wire end over the blade of the knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute elevations and cavities on the blade, caused by the structure of the steel and which again cause minute alterations in the intensity of the current, are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar scraping noise. If, now, the plate of one instrument, as in Figs. 1 or 5, is vibrated by sound-waves (which happens whenever any kind of sound is uttered or is produced by musical instruments in its neighborhood) every wave or vibration that strikes the plate produces between the two sides of the contact a variation of pressure, which causes a variation of resistance at that point, and therefore a variation in the strength of the passing current, and if the sound is sufficiently strong it will break the circuit at said point of contact, the variations in the current thus produced causing similar vibrations in the plate of the receiving-instrument. The essential part of the apparatus is the point of contact, which must offer a resistance to the current.

It is not necessary in the transmitting apparatus that the plate should be of conducting material, for any substance capable of vibration will answer, if only at the point of contact provision is made for the current to pass. It is sometimes convenient to use a vibrating plate in the form of a reflector, as shown in Fig. 6, for concentrating the sound, or the diaphragm may be provided with a number of apertures to disperse the sound, as shown in Fig. 7. These apertures prove advantageous with strong sounds, particularly the hissing sounds, as while the sound-waves are rushing towards the diaphragm, those touching the plate are repelled and partially destroy the following waves, just as sea-waves when forced against a cliff will be thrown back, destroying those directly behind. The holes permit most of the waves to pass to the other side of the plate, making the vibration of the plate more perfect and even.

I will here describe a recording apparatus, which, however, I do not claim.

In Fig. 3, *e* is a galvanometer, which is located in circuit with the contact-pieces or electrodes A B, and which serves as a convenient means for ascertaining the adjustment of the contact-pieces of the transmitter, so that a current shall pass. *i p i* is a Ruhmkorff coil or induction apparatus. When a current

passes through the primary coil p and suddenly is broken, a spark will rush over between the ends of the secondary coil i i at q. This spark is accompanied by a peculiar sound due to the electric discharge, and if we bring between the ends of the secondary the connecting-points r r r r a spark will occur between each of them, provided they are near enough to each other, and the peculiar sound will be heard between each of them. I now arrange a strip of chemically-prepared paper or other substance n to be drawn by clock-work T between the ends of this secondary wire at q. Said strip can be prepared in such a way that each spark will produce a mark upon it. If, therefore, the plate A vibrates by sound, each vibration causing a break of contact will produce a spark at q, and the strip being drawn through, a succession of marks will be produced upon the strip according to the number of vibrations caused by the sound; but at the same time the sound which was uttered at the plate A will be heard from the sparks rushing over the points r, r, r, r, and q, because every spark produces one wave in the atmosphere in which it occurs, and a certain number of waves will therefore produce certain tones. Therefore the same sound which is uttered against the plate A will be heard from the sparks. The scraping of the wire end on the knife-blade k, as in Fig. 4, in the primary current will also be heard between the wire ends of the secondary current at r, r, r, r, and q. This permits a number of designs for a receiving apparatus within the secondary current. For instance, initials, ornaments, etc., consisting of a number of metal pins can be constructed in such a way that whenever a tone is produced against the plate A a spark will rush over said metal pins, and at the same time their sound is produced will render the design visible in illuminated characters.

By making the person of the operator a part of the secondary circuit and discharging the sparks in the body in the neighborhood of the ear the sound will be more particularly apparent.

It will be observed that in Figs. 1 and 2 one of the electrodes presents a convex curvilinear surface like a rounded knob. This possesses some advantages, among which are ease of construction and durability, because it does not wear away the opposing electrode as much as a sharp one would, and when the contact with the vibrating body is made of such a form the freedom of the vibration is less interfered with.

I do not claim that I am the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound-waves accompanying said sounds. Neither do I claim that I am the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing.

I do not herein claim the novel form of vibratory-plate receiver which I have described, because that is a subject of claim in another application.

I claim—

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly-held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephonic transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephonic transmitter, a vibrational plate provided with one or more apertures, as and for the purposes set forth.

6. A speaking-telephone transmitter comprising a diaphragm or disk sensitive to sound-waves, combined with a rigidly-held but adjustible electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

In testimony that I claim the foregoing I have hereunto set my hand in the presence of the subscribing witnesses.

EMILE BERLINER.

Witnesses:

J. A. RUTHERFORD,
JAMES L. NORRIS.

MR. KEELYN ON THE TELEPHONE SITUATION.

With regard to the effect of the latest Berliner decision, Mr. J. E. Keelyn, of the Western Telephone Construction Co. of Chicago says:

"We look upon the appellate decision as favorable to the legitimate telephone business. The Bell Company will have no greater monopoly through this happening than it would have had otherwise. The public will be provided with thoroughly first-class telephone apparatus by companies independent of the Bell, and these independent companies will not be annoyed and troubled by the irresponsible and unreliable concerns that have promised to injure the chances of fair profits on decent business lines. Now, care and investigation will follow, and a survival of the fittest ones will ensue. The public and the trade will be better off.

"The Western Telephone Construction Co. has made no change in its policy. Conservative lines have left it unaffected by the results just announced in the Berliner case."

ALUMINUM ALLOY FOR TELEPHONE TRANSMITTER DIAPHRAGMS.

IN a patent just issued to G. A. Nellis and Florence S. Weisser, of Allegheny, Pa., the inventors claim that great clearness of sound and other properties are secured by employing for the diaphragm of a telephone transmitter an alloy of the following proportions: Aluminum, 94 per cent.; nickel, 4 per cent.; iron, 1 per cent.; silicon, 1 per cent. This alloy receives and maintains a high polish, does not become tarnished and is exceedingly springy and sonorous.

SHREVEPORT, La.—The Co-Operative Telephone Association of Shreveport has contracted with the Brown Electric and Machinery Company of Little Rock, Arkansas, for a plant and a central office with equipments for 850 telephones, including the erection of the line and its connections at all points in the city.

A TELEPHONE TRANSMITTER WITHOUT ELECTRODES.

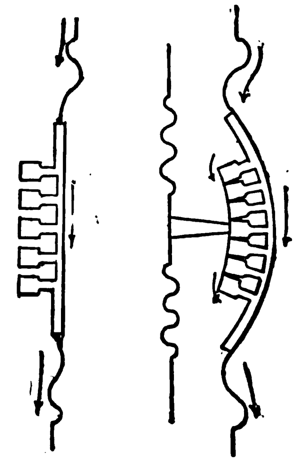
Mr. Herbert Cottrell of Newark, N. J., writes us as follows:—

REFERRING to that part of your editorial in last week's issue in which you say, "it is the opinion of not a few that an entirely successful telephone transmitter can be designed which does not come under the claims of Berliner," I am prompted to recall your attention and that of your readers to an illustrated article which appeared in your issue of July 25, 1894, describing a new form of transmitter.

The Berliner decision gives to the American Bell Telephone Company a monopoly of all chemical battery telephone transmitters which operate with "electrodes in constant contact." A telephone transmitter constructed *without electrodes* would therefore be free of such monopoly, as not coming within the scope of Berliner's claims; such is the character of the transmitter above referred to.

It comprises an electrical resistance piece, which forms a shunt having a path of high resistance, formed of a flexible strip, which has projections extending therefrom, of low resistance, providing an easy path for the current when the strip is bent, so as to bring them into contact.

In order that this brief description may be rendered more clear, I refer to Fig. 1, showing the resistance piece in its flat



COTTRELL TELEPHONE TRANSMITTER WITHOUT ELECTRODES.

position, in which the current passes through the high resistance strip; and in its bent position, Fig. 2, in which the current is then shunted through the low resistance projections, in correspondence with the movements of the diaphragm.

Inasmuch as a "break" in the circuit, in this form of transmitter, is impossible (without breaking the instrument), it follows that all harsh noises from such cause are eliminated, and the articulation rendered perfect and natural.

The instrument will do good work with one Fuller bichromate cell, and has been tested with four such cells, thus showing its capacity for long distance work. Changing the dimensions of the resistance piece accommodates the passing of any desirable quantity of current.

THE TELEPHONE AS AN ALARM CLOCK.

A Portland business man has hit on a new scheme says the *Boston Herald* for being awakened at the proper time in the morning, which he declares beats any alarm clock that ever was invented. He has his telephone in his bedroom, and each night when about to retire he calls up the central office, and requests the operator to call him up at a designated hour, in order to find if the "phone" works properly. Promptly at that hour the bell rings loudly, and he is awakened with neatness and dispatch. He claims that the service thus rendered is alone worth the annual rental of the telephone.

It will be remembered by old telephonists that several years ago the Oram system was introduced for telephoning time to subscribers at a small additional fee, by means of ticks; but it gradually lapsed into oblivion and inutility.

TELEPHONE NOTES.

ABBEVILLE, LA.—R. F. Hogsette will build a telephone line from Abbeville to Garlands ranch, twenty miles west.

FAYETTE, ALA.—John Young, of Vernon, is establishing a telephone between Fayette and Vernon and other connecting points.

TELEPHONE NOTES.

ALPENA, MICH. is to have a mutual telephone company, the profits to go to the subscribers.

SUSQUEHANNA, PA.—The Montrose Telegraph and Telephone company has been chartered.

RAVENNA, O.—The Portage Telephone company has been formed; capital stock $25,000.

NEW CASTLE, PA.—A new telephone company in New Castle has secured 205 subscribers with three year contracts.

SIOUX FALLS, IA.—The Northwestern Telephone company will construct a telephone line from this city to Dell Rapids and Egan.

WAUPACA, WIS.—The Badger Telephone company is putting in an exchange at Waupaca.

ASHLAND, KY.—The Catlettsburg Telephone Company will connect with all the mills of Arigo and Sandy City.

NANTUCKET, MASS.—The organization of the Nantucket Telephone company has taken place. T. W. King was chosen president; Isaac Hills, secretary; Charles H. Mowry, treasurer.

CHEROKEE, MINN. is to have a telephone exchange managed by a private company. The rentals are $2 per month for all instruments.

MITCHELL, S. D.—The Mitchell city council has refused to grant the Mitchell Telephone company a twenty-year franchise, being willing to give one for five years only.

WEST TISBURY, MASS.—The selectmen have granted Dr. C. F. Lane the privilege of extending his telephone line through the town. The line will ultimately be extended to Gay Head.

SULLIVAN, ILL.—Arrangements are being made for the construction of the telephone line to connect Sullivan, Lovington, Decatur and intermediate points.

BUTLER, O.—The People's Telephone Company has been formed; capital, $10,000. Incorporators: Oscar Wise, John L. Barr, Floyd E. Wise, W. L. Hissong.

PLYMOUTH, WIS.—W. F. Chaplin of Sheboygan Falls has secured a franchise from the city of Plymouth for a telephone system, which is now being put in.

HINDMAN, KY.—The citizens of Hindman, the county seat of Knott county, have subscribed $5,000 for the construction of a telephone line to that place from Dwale, Floyd county.

ALLIANCE, O.—The Harrison Telephone Company of Chicago have a representative in the city, arranging to establish an exchange here.

NEWARK, O.—The Central Union Telephone Company are placing telephones along their lines in the city for one year without charge.

LAKE CHARLES, LA.—The Dees Telephone company has been organized with an authorized capital of $25,000. The officers are George Lock, president, A. P. Pugo, general counsel and Elly H. Dees, secretary, treasurer and general manager.

ORTONVILLE, MINN.—Twenty of the representative business men of this city and Big Stone City, S. D., have closed a contract for a telephone system in and connecting the two cities and all the business houses represented.

PETERSBURG, VA.—The Mason Telephone Company of Richmond has been awarded the contract for installing the exchange for the Mutual Telephone Company of Petersburg. The company expect to begin business about the 1st of July next.

CHILLICOTHE, O.—The Western Telephone Construction company of Chicago has been awarded the contract of equipping and placing in operation the Home Telephone company of this city, which will compete with the Central Union company.

DETROIT, MICH.—An organization of the Michigan Harrison Telephone Co. has been made by electing O. W. Shipman, president; R. A. Brett, vice-president; Dr. McLaren, secretary, and Charles A. Hurlburt, general manager.

BIG RAPIDS, MICH.—The Bell Company has absorbed the Escott telephone system established here a few months ago. Paul Escott, the proprietor of the Escott system, has been retained as local manager for the Bell Company.

SIOUX CITY, IA.—The Home Telephone company has filed articles of incorporation. It will soon have its lines in working order, and will furnish instruments at a much smaller price than they have ever been given before.

MT. VERNON, O.—The Mt. Vernon Telephone company has made a contract for a 175-telephone plant, with a central office in the First National bank building, to be completed and in working order by June 15. The rates are $30 for business houses and $18 for residences. The Central Union has reduced its rates to $36 and $24.

FORT VALLEY, GA.—The Fort Valley & Perry Telephone Co. has been formed to put in a line at once to Perry; C. W. Withoft, president; T. V. Fagan, vice president; W. P. Harwell, general manager; George L. Keen, secretary and treasurer.

JONESBORO, TENN.—The Nola Chucky Telephone Company, with headquarters at Jonesboro has commenced work on a line from Jonesboro to Elizabethton and contemplates building from Embreeville to Johnson City, thence to Elizabethton.

FREDERICKSBURG, VA.—Mr. C. R. Rouzie, who is superintendent of the construction of the Occoquan-Woodbridge Telephone Company, is engaged in putting up the poles and stretching the wires of his company in this city.

MIDDLETOWN, N. Y.—The stockholders of the Orange County Telephone Company held a meeting at which a permanent organization was effected by the election of the following officers: President, A. B. Wilbur; Vice-President, Dr. E. Fancher; Secretary, George A. Swalm, Jr.; Treasurer, Frank Harding.

NEW BRITAIN, CONN.—The New Britain Telephone Company has been organized with a capital of $25,000 in 1,000 shares of $25 each, 20 per cent. paid in. The subscribers are R. L. Andrews, 883 shares, Richard Schrey, 883 shares, and numerous other residents in New Britain.

MANCHESTER, IA.—Articles have also been filed by the Manchester Telephone company. The capital stock is to be $12,500. The incorporators are H. A. Anderson, H. C. Haeberle, C. H. Day, H. C. Smith, C. A. Peterson, Albert Hollister and R. R. Robinson.

COVINGTON, KY.—The Tristate Telephone and Telegraph Company has entered the Covington field in opposition to the District Messenger Telegraph Company, and has made a proposition to the Board of Councilmen looking to the securing of a franchise to operate in this city.

FARMINGTON, ME.—The Franklin Telephone and Telegraph Co. have now in operation 15 sets of instruments, reaching the following places: New Sharon, Farmington Falls, West Farmington, Farmington, Fairbanks Strong, Phillips, and the Rangely lake region, and are putting in more as fast as they can be strung up.

BUFFALO, N. Y.—The Mutual Automatic Telephone Company has secured a franchise to operate a telephone line between the municipal departments, with a view to the general introduction of its wires. The rates charged are only about one-third what is charged by the Bell company.

SANTA FÉ, N. M.—The La Belle Telephone company has been formed for the purpose of building, owning and maintaining telephone lines in the territory of New Mexico. Capital stock, $50,000. Directors, H. C. Fortson, J. W. Bayne, E. P. Twitchell, A. G. Slith and E. C. Van Driest. Principal place of business, town of La Belle, Toas county.

WICHITA, KAS.—An ordinance has been passed by the city council imposing a license tax of $17 per annum on each instrument used by the Missouri and Kansas telephone company. The company charges $42 annual rental per instrument while several new companies are asking for franchises and agreeing to put in a maximum charge of $35 per annum.

PITTSFIELD, MASS.—The Union Telegraph and Telephone company of Pittsfield obtained its charter Nov. 13, 1894; its capital stock being placed at $5,000, with power to increase. Soon after that, the company organized with S. N. Fuller, president; M. Casey, treasurer; John S. Wolfe, secretary; S. N. Fuller, M. Casey, John S. Wolfe, R. A. Burget, J. L. Bacon, E. T. Castle, directors.

OSKALOOSA, IA.—The Oskaloosa Telephone company has been organized by business men of Oskaloosa; capital stock is $30,000. The officers of the company are: President, W. H. Kalbach; general manager, S. T. Slade; secretary, E. K. Hines; treasurer, F. E. Green. The Iowa Union company have made a public announcement that they will reduce rates from July 1st and they will fight the new company at every point.

DETROIT, MINN.—A telephone company has been incorporated for putting in a telephone system between here and Lake Melissa, a very beautiful summer resort 10 miles south. It is also the intention to extend the wire to Fargo, N. D. The company will be known as the Detroit Telephone Company. They elected officers as follows: President, T. A. Nottage; secretary, J. K. West; treasurer, J. E. Furber; trustees, W. E. Reed, E. McNell and C. K. Day.

LOUISVILLE, KY.—The American Telephone and Telegraph Company of Kentucky has been incorporated. The stockholders and the amounts owned by them are as follows: Edward P. Meany, of Newark, N. J., eighty-eight shares; Melville Egleston, Elizabeth, N. J., three shares; James Clark, Louisville, three shares, Edward F. Trabue, Louisville, three shares and William B. Meany, Louisville, three shares. The capital stock is $10,000 and the greatest indebtedness to which this corporation can go is $100,000.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE WATER POWER PLANT FOR THE COLUMBUS, GA., ELECTRIC RAILWAY.

The development of electric railway work at Columbus, Ga., is now in a very interesting stage, particularly as regards the utilization of water power for the work. The Columbus Street Railroad Co. are now operating twenty miles of street railway by electric power, the plant being placed in the river near the City Mills. The new power house is now being built and equipped, James Leffel & Co., furnishing a complete plant, on contract, of their well known "Samson" wheels. The Consolidated Company has been operating about 20 electric cars, of Thomson-Houston make, by steam power. The new water plant for generating purposes is herewith illustrated in Figs. 1 and 2. It comprises four of the Leffel "Samson" wheels of about 1,000 H. P. Our cuts simply show half of the equipment. Upright shafts are used, with a fine outfit of steel beam work, bridge trees, gears, shafting, pulleys, clutches and governors. When this plant is fully equipped, the company proposes not only to run its own road but to furnish motive power for all the small industries in the city. The officers of this progressive company are: J. F. Flournoy, president and chief engineer; E. J. Rankin, vice president; R. Brown, secretary and treasurer; F. E. Knapp, superintendent.

It may not be generally known that the Chattahoochee River, in the vicinity of Columbus, has some of the finest water powers in the South. In addition to the water power above referred to, the North Highlands Co. has a large undeveloped one on the northern limits of the city. There are various other reserve powers available. Mr. Grigsby E. Thomas, Jr., an active Columbus lawyer has interested a number of people in a plan for changing the Columbus & Rome narrow gauge steam road. Mr. Thomas is kind enough to write us as follows:—"Of course you know that the river on which our city is situated is the Chattahoochee, having its source in Northern Georgia; and the same river runs within eight miles of Atlanta. That city is proposing to put in a large electric plant, and furnish the motive power to her street railroad and other industries. The Columbus & Rome narrow gauge road extends from here to Greenville, a distance of 51 miles. The Atlanta Consolidated Street Railroad have extended their railway to Manchester a distance of 15 miles. It is about 50 miles from Manchester to Greenville; and I have written to the parties controlling the Columbus Railroad and the Atlanta Consolidated Street Railway to unite and purchase or lease the Columbus & Rome and complete it to Manchester. I have suggested, if practicable, to have through trains operated electrically, running over that road between Columbus and

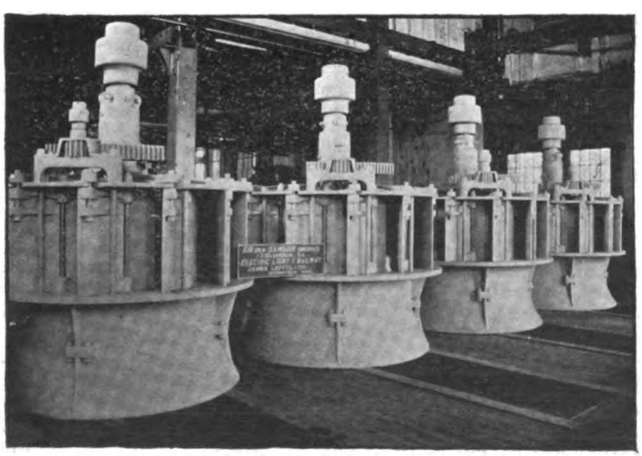


FIG. 1.—WATER WHEELS FOR THE COLUMBUS, GA., STREET RAILWAY.

Atlanta to and from the Cotton States Exposition next October. I think it would be as well patronized as the Ferris wheel was at Chicago, and would bring as many people to Atlanta to see and ride upon this first long distance electric road 120 miles in length, operated by power all furnished from the one and the same river at different points.

"Moreover, Columbus has another standard gauge steel rail first class road extending from the city to McDonough a distance of 100 miles, and about 28 miles from Atlanta. This road is known as the Georgia Midland & Gulf, and is in the hands of a receiver, under proposed plans of reorganization. I have also suggested to the parties controlling the latter system a plan of reorganization, that the bondholders of the said road consolidate with the street railroad companies of Atlanta and Columbus and complete the road into Atlanta. They would thereby secure terminal facilities in both of the cities and have a road equipped for electrical passenger service between the two points. Along

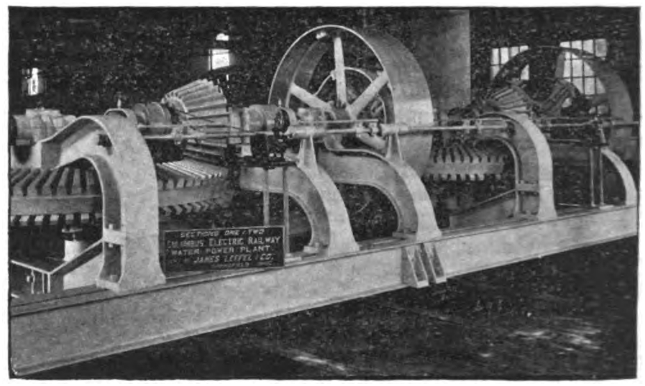


FIG. 2.—TWO SECTIONS OF TRANSMISSION GEAR, COLUMBUS, GA., WATER POWER PLANT.

both the C. & R. R. R. and the G. M. & G. R. R. are large creeks furnishing sufficient water power, as feeders, to assist in operating the main electrical power between Atlanta and Columbus."

The plan outlined above has still to take definite shape, we believe, but it does credit to the foresight of Mr. Thomas, and has no weak point that is apparent. The main question would be the ability of the water powers to take care of this large system.

WOMEN INVENTORS OF CAR FENDERS.

Among the inventors of car fenders appearing recently before the New York Board of Aldermen, to exhibit their models, was a young lady named Maidhoff. It is said, however, that she is not the only woman inventor in this class, and one of the evening papers, by way of confirmation, tells the following funny story:—

"Av all th' fool cyar finders Oi iver saw," said a mechanic in the employ of a street railway company, "th' wan that the lady invinted was th' worrst. Ye see, she was a frind of th' boss, an' he give her a cyar to fuss wid, and she had t'ree min worrkin' for her for a little shart av a year before she give ut up, an' thin she didn't give it up—divil a wan—but th' boss confishcatud fwat was left av th' cyar.

"Oh, but th' finder was a grate bit of mintal iffart entirely. Ut was made av wrart iron complately and ut weighed maybe a ton or so, and ut shtuck out a matter of siven fate beyant the cyar, and ut had four whales to run on. And, av corse, there was anuther wan jist loike ut trailin' behoind the cyar all th' toime. So that was no liss than twilve whales that blissed cyar had to carry, havin' four av ut's own to run on.

"Will, ut was th' divil's own toime we had. Th' lady, she'd come around ivry day an' change somethin', an' there was nothin' that suited her—an' no wander, for th' min that was worrkin' for her knew well that the job would be gone whin the finder was finished, for ut was no good at all, an' they was that stupud ut would brake your heart. Oh, ut was nothin' they cud undhershtand! "Yis, mum," they wad say. "Yis, mum, ye want ut this way," an' as soon as she turned her back ut's th' other way they wad do ut. Oh, ut was pittiful!

"But, by good luck, th' thing wos done bye an' bye. All th' philosophers about th' shop came an' looked ut over, and ut wos little they cud say for laughin' at ut. An' as th' lady didn't come back for a long time, we thought she'd guv ut up at last. 'Throw ut in th' scrap heap, bhoys,' said th' foreman, 'for ut is no dam good, an' ut's lucky ye've been t' have a steady job these nine months.' So into th' scrap heap ut went. But no sooner was that done than back comes th' lady in a big open carriage wid a party of friends to see th' finder work, an' a big bag o' sawdust to take th' place of th' victim.

"An' thin there was grate goin's on in th' shop, but th' awful thing was fished out an' be hook or be crook ut was put on a cyar an th' ladies an' gintlemen got in an' off we wint. At th' firrst curve in th' thrack th' thing shtuck fast be rason of th' twilve whales, but that was a mere thrifle an' ut was pried out wid a crow bar an' away we wint again.

"When we come to a bit av a livil stretch beyant th' city limits the bag o' sawdust was laid gintly on th' thrack, and th' ladies an, gintlemen all got out to see th' finder pick ut up gentle like. An' ut's lucky for thim they did for th' finder not only bruck th' bag an' and schattered th' sawdust very bad, but ut was knocked off and jammed undher the cyar, breakin' th' front axle an' bindin' th' motor, an' we all wint back in th' emergency wagon.

"Ut was a sorry day for th' lady, but maybe she can make cake an' sich things betther than cyar finders."

THE CULVER ELECTRIC "PACEMAKER."

We illustrate herewith a curious and ingenious invention made by Mr. C. R. Culver, of Springfield, Mass., a bicycle expert and trainer, for the purpose of pacing wheelmen and lowering the record. The machine has three wheels, is eleven feet long over all, pointed at the front end, and from four to five feet high. To avoid air resistance as far as possible, the contrivance is shaped like half of a torpedo boat. The curved roof or top extends back beyond

THE CULVER ELECTRIC PACE-MAKER.

the body of the machine, affording a shelter from the wind to the flying record-breaker.

The carriage is mounted on ordinary bicycle wheels, with pneumatic tires, somewhat heavier than usual. The motive power is derived from a storage battery, applied to a motor driving on the rear axle. The operator sits well forward, and controls the motor which steers the machine by means of a lever. Three-horse power is required to run the machine, which weighs 700 pounds. It is designed for a straightway track.

ELECTRIC RAILWAY LEGISLATION IN CANADA.

The Dominion Electric Railways Act of 1895, contains provisions that are intended to prevent stock watering and the other objectionable practices of corporations. All shares of stock will be deemed to have been issued for and held subject to the payment of the whole amount in cash. The exact disposition of the capital must be set forth in detail—how much for promotion expenses, for surveys, plans and estimates. The remainder of the capital is to be applied in making, equipping, completing and maintaining the road. No director may be an employee of the company, nor interested in any contract under it. Electric companies are required to make reports to the government, in which the division of capital into ordinary and preferred shares, the amount of bonds, municipal loans, bonuses, subscription to shares and bonds, and all sources of capital, must be shown. The actual amount of cash paid in, as well as the actual cost of stock; the earnings, and a summary of working expenses, are to be included in these reports.

BROOKLYN ROADS IN BAD CONDITION.

President Vreeland, Treasurer Thomas F. Ryan, and Chief Engineer Pearson of the New York Metropolitan Traction Company, have submitted a report, as railroad experts, upon the physical condition of the surface lines controlled by the Brooklyn Heights Railroad Company. Although the report will not be made public until acted upon by the proper authorities, it is said to be of a severely critical nature. The present tracks are pronounced to be in very bad condition. They will have to be almost entirely relaid, and an outlay of between $3,000,000 and $4,000,000 will be necessary to put the road in good operating condition. The report says that 20 per cent. too many cars have been operated, considering the amount of travel.

YOUNGSTOWN ECONOMIES.

The electric railway companies at Youngstown have resolved to put fare boxes in the cars, dispense with conductors and make the motormen act as conductors.

LEGISLATION ON STEAM AND ELECTRIC ROADS.[1]

BY G. M. WOODRUFF.

Until recently the motive power used has been regarded as sufficient to differentiate a "railroad" from a "street railroad." A Connecticut statute says that the phrase "railroad company" shall be construed to mean and include all corporations, trustees, receivers, or other persons that lay out, construct, maintain, or operate a railroad operated by steam power, and a further provision is that no horse railroad company shall use steam for motive power, and these two provisions have been regarded as sufficiently distinctive definitions.

A distinction has also been made by our text books based on what has been a characteristic of the business of the respective corporations. So recent authority as Elliott defines a street railway to be a railway laid down upon roads or streets for the purpose of carrying passengers, and says that the distinctive and essential feature of a street railway, considered in relation to other railroads, is that it is a railway for the transportation of passenger and not for freight, and the definition given by Booth is almost identical; but the leading railroad company of Connecticut is already equipping a branch line for the use of electricity, and other railroad companies are doing like work, so that the motive power can no longer be regarded as sufficient to determine the distinction between a "railroad" and a "street railway;" neither is the character of the business performed any longer distinctive, since electric roads are already engaged in all the kinds of transportation in which steam roads are engaged.

We have not at hand any statistics up to date, but six months ago, at the time of the Atlanta convention of the American Street Railway Association, out of 413 companies reporting, all of course doing a passenger business, 85 were also doing express business, 55 were transporting freight, and 62 were carrying the United States mails, and this, too, notwithstanding the fact that in at least three states such companies were forbidden by general laws from carrying either express or freight, and like prohibitions were incorporated in charters granted in other states. It appears, therefore, that in practice the distinction based on the character of business done is disregarded, and the courts of at least one state—California—have declared that no good reason for the distinction exists, but that the transportation of freight by modern and improved methods is equally entitled to encouragement with the transporting of passengers, and equally demanded by the wants of the citizens.

Again, the old distinction based upon the location of their tracks no longer exists. Elliott defines a street railway to be one laid down upon roads and streets, and Booth says, "Street railways are those which are constructed in the streets, whether on, below, or above the surface." But the electric roads, while taking advantage of these routes provided for them without cost, do not confine themselves to the existing streets and highways, but have their own exclusive locations in the same manner as steam roads; and at last the courts in one state have placed these companies on the same footing as steam roads in denying their right to the occupation of the highways, outside of city limits, except by consent of and compensation to the adjoining owners.

This Pennsylvania decision, if sustained, would place electric roads outside of city limits on the same footing with steam roads in regard to the necessity for securing their own right of way, and as a necessary incident thereto it would seem requisite that the right of eminent domain should be conferred upon them. Whether such right has as yet ever been conferred we do not know. So long as the construction of these roads was permitted in the streets and highways without compensation to adjoining proprietors no such right or power was required, and heretofore it has been the policy of their projectors to avail themselves of the privileges attached to the old horse railways, rather than seek additional powers which could only be exercised at a cost out of proportion to the privileges acquired. But if the electric roads, when they become intertown or interstate roads, are to be compelled to secure their own rights of way, and we believe they should be so required, then there must be at the same time conferred this right of eminent domain, as their construction would otherwise be impossible.

In all cases the use must be public as a foundation for the exercise of the right of eminent domain, and though the right be conferred upon an individual, as in the case of a mill owner, the right can not be exercised till the tribunal named by the legislature has first found the taking of the lands will be a public use, or unless the legislature itself so finds.

In conclusion we would say briefly that it seems to us that electric railway companies seeking to build roads from one town to another, or through adjoining towns from one state to another, should be authorized so to do either by general laws or by special charters, with like privileges as steam roads, but subject to like conditions, restrictions, and regulations as to lay out or location, especially at highway crossings, construction, operation and supervision, both state and interstate, as are applied to steam railroads and railroad companies.

1. Abstract of paper read before the Washington Convention of Railroad Commissioners.

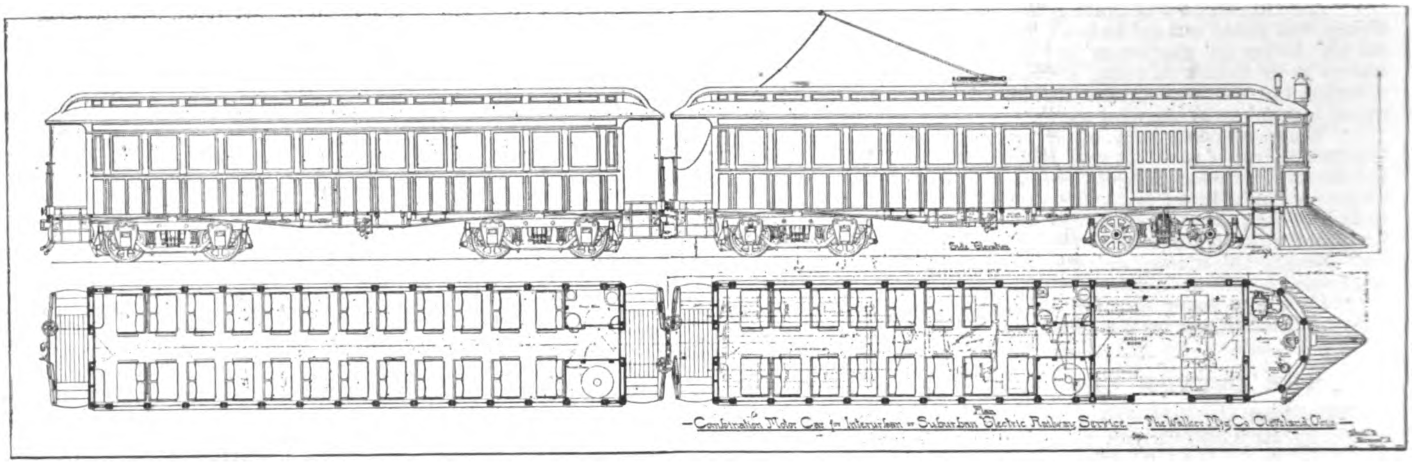


FIG. 1.—THE WALKER MFG. CO.'S COMBINATION INTER-URBAN ELECTRIC TRAIN.

THE INTER-URBAN ELECTRIC RAILWAY.[1]

BY PROF. SIDNEY H. SHORT.

THAT the electric railway, when properly constructed and operated, is best adapted for inter-urban service, is fast being acknowledged by all classes of railway men, and the eagerness of capital to invest in such undertakings is growing daily. I therefore propose to discuss the various points developed in this new branch of travel, from the side of the practical working; making an effort to care for both the comfort of the passengers, and the assets of the Company.

After selecting the country through which an inter-urban railway is to be run, the point of next greatest importance is, where the road bed should be constructed. There are two possible locations, one along the existing common highway connecting the termini of the road, the other over a private right of way similar to a steam railway. Each has a number of points in its favor, and generally local conditions must be considered in making a decision. The latter is most tempting in its freedom from obstructions consequent upon the general travel of a highway; the power to establish the grades and curves, and chiefly the liberty to maintain a high rate of speed. It will be most advantageously used when the road is intended to operate between a few stations at considerable distance apart. But in most cases it will undoubtedly be best to adopt the public highway, as along this road will be found the greatest number of people, and upon them the success of the road depends. These highways are usually arranged with two roadways, one well macadamized, the other a dirt road. On either side of these is often found a considerable space, before the fence line is reached, which is used for drainage purposes, and with very little work one of these spaces may be prepared for the track.

In the construction of the road I would advocate as few grades (never exceed 5 per cent. or 250 feet per mile) and curves as possible, owing to the high rate of speed which it will be necessary to maintain, but always keeping near the highway. The roadbed itself should be prepared according to the best received practice in steam railway construction—ties close together—a sixty or seventy pound rail and stone or gravel ballast, with the rails far above the surface of the road, which keeps them clean and dry, affording good traction and a smooth rail. As much care should be taken in holding the rails at the joints and upon the ties, as though steam passenger trains were to be operated on the line.

The rolling stock equipment for the Inter-Urban Electric Railway requires most careful and intelligent consideration. The requirements differ so greatly from ordinary street railway customs that we have little to guide us save steam railway practice. I will therefore endeavor to place before you information gained from the use of electric motors for tractive purposes, and apply it to the new condition met with in this class of work. In almost every case the inter-urban road enters into competition with some steam railway, and is therefore called upon for the same or better service—so high speed is the first requirement.

The cars should be built like those found most practical for passenger coaches on steam roads. The body should be about 40 feet long—50 including the platforms; mounted on double swivel trucks which have 33 inch or 36 inch wheels with wide tread and deep flanges. The wheels should all be of the same size and the trucks centrally pivoted so the weight will be equally distributed on all the wheels. The trucks should be provided with both elliptical and spiral springs as on all high speed coaches. Such a car will seat 50 passengers, hold 100, weigh empty, about 12 tons, and about 22 tons when filled with passengers and fitted with its electrical equipment of 50 H. P. motors. This car will run at a speed of 35 miles an hour on the level, and make a schedule time of 25 miles including stops and slow speed on curves and grades.

The motors should be mounted one on each truck. The controlling apparatus should consist of the ordinary series parallel controller, worked by hand, and an air brake outfit of the regular Westinghouse type, with an air compressor operated by a separate motor automatically controlled by the air pressure. This air pressure may be made to operate a signal whistle, and to force water from a tank under the car into wash basins, closets and drinking faucets.

Many roads are now being projected and built, like the branch lines of the P. R. R. and N. Y. C. R. R. upon which the traffic will require a train of two or more cars, and a speed of from 40 to 45 miles an hour must be maintained on a level with a fully loaded train, in order that a schedule time of 35 miles per hour may be made.

Fig. 1 illustrates our standard train of two cars designed for inter-urban service. This train is composed of a combination car provided with two single reduction 100 H. P. motors and is arranged with a baggage compartment large enough to receive

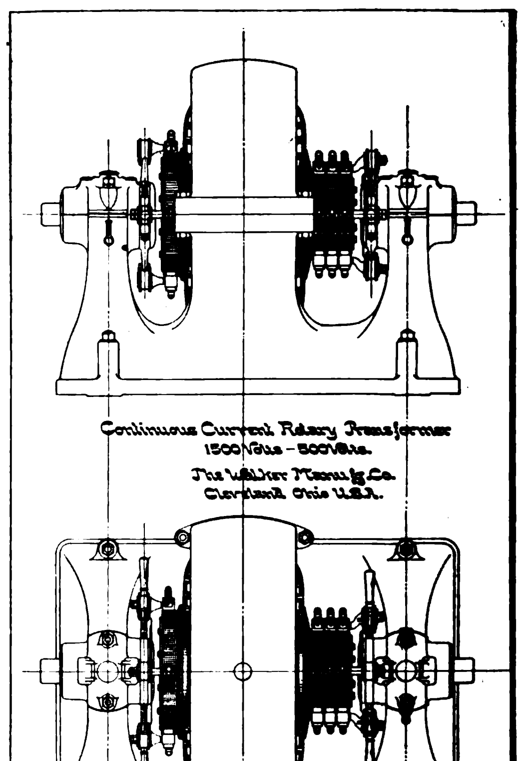


FIG. 2.—WALKER CONTINUOUS CURRENT ROTARY TRANSFORMER.

1. Abstract of a paper read before the Cleveland Electric Club, May 22, '95.

the baggage, mail and express matter which these inter-urban trains must carry. The rear half of this car is set apart for the accommodation of about 35 passengers and can be used as a smoking compartment. The front platform of the combination car is inclosed to form the motormen's cab, and in it are placed the air compressor, engineer's brake valve, controller, auxiliary hand brake and whistle valve. Each car in this train will be about 50 feet over all, making a train length of over 100 feet and having a total weight of about 46 tons when fully loaded with 150 passengers and about 7,000 pounds of baggage.

Engineers in dealing with problems in inter-urban railway

12 Ton Car with Double 50 H.P. Equipment — Weight Complete, Loaded = 22 Tons. — THE WALKER MANUFACTURING CO. CLEVELAND, OHIO.					
% Grade	Speed Miles per Hour	Total Current	H.P	Efficiency	Horizontal (lbs) Force
0	35.5	54	28	77.7	294
½	29.5	67	37	82.3	460
1	25.6	83	47	84.7	670
1½	23.1	97	55.5	85.6	886
2	21.4	110	63.4	86.0	1090
2½	20.0	123	70.6	86.0	1300
3	19.0	134	77.2	86.0	1500
3½	18.2	146	84.0	85.8	1710
4	17.5	158	90.6	85.6	1935
4½	16.9	169	96.7	85.2	2150
5	16.4	180	102.2	84.7	2360

TABLE I.—50 H. P. MOTOR PERFORMANCE.

should exercise the greatest care in making out specifications for cars, motors and generating plants, as there has been very little data obtained from larger motors than the so called 25 H. P. machine, and their performance on ordinary street railways. I take the liberty to present a number of facts gleaned from our own experience, and all conformable with regular practice which may form a basis for all preliminary calculations.

The standard motor will give its full rated brake horse power for one hour without heating more than 150 degrees above the surrounding air. This motor will not run continuously doing this work without danger to its insulation, but it may temporarily, in starting or accelerating a train, take 100 per cent. overload without injury or sparking, while the efficiency at this extreme overload will remain high. Such are its peculiarities.

In modern street railway service it has proven best to adopt two of these standard motors for operating one car. They are found to consume on the average about one-fourth their rated current and do the work easily without overheating. We therefore do not advise the adoption for inter-urban trains, of motors of smaller capacity than will, with one-third their rated current, move the loaded train along a level track at the required speed, and the efficiency of these motors should be almost constant at from 80 to 90 per cent. from one-third load to 50 per cent. overload.

The author gives curves of efficiency, speed, horse power, horizontal effort, etc., obtained from his standard 50 H. P. and 100 H. P. motors. He gives also Tables I. and II. showing the performance of these motors with their trains on grades from level up to 5 per cent., which is the limit at which grades should be allowed. From these curves and tables approximate data for other conditions can be calculated.

Our last problem is that of the distribution of power to our railway system. It is seldom practicable to have more than one power station, so it is always best to place the station as near the centre of the line as possible, and feed in both directions. Where the line is short and traffic not heavy this can easily be done, but when long, several methods may be used to maintain a constant E. M. F. The "booster" system is one which may be used where fuel is inexpensive, and consists in placing a small series machine on the long feeders, whose capacity is just large enough to supply the losses and maintain a constant E. M. F. on the distant trolley. This may be carried to any extent, but is not economical, as the extra watts are all absorbed by the feeders and do no useful work. The alternating current method, by which the feeders are charged with a pressure of 2,000 volts or more, and rotary transformers used at intervals to reduce the pressure to 500 volts and change the current to a direct one, is very good, but the regulating apparatus is very complicated.

A more direct and practicable method we believe is to have an armature wound for both 500 and 1500 volts, with a commutator on each side. This needs no separate exciter and can be so designed as to regulate for the drop on the trolley feeders, as the load comes on, thus maintaining absolutely the full E. M. F. so necessary for high speeds. Prof. Short has recently designed machines of this character and believe they will give better results than any other method proposed. See Fig. 2, page 496.

Table III. gives a comparison of the amount of copper necessary in the feeders for a 50-mile road, running trains of two cars equipped with 100 H. P. motors, at one-half hour headway, eight trains in operation at all times, when fed from a central station at 500 volts by the old method, and with 1500 volts using substations with these direct current transformers.

RELATIVE AMOUNT OF COPPER REQUIRED WITH AND WITHOUT ROTARY TRANSFORMERS.

Figures based on a 50-mile road, double track, 8·64-ton trains each equipped with 2-100-H. P. motors, schedule time 25 miles per hour. Resistance of return, ¼ of total.

TABLE III.

1 Central Station.	1 Central Station.	1 Central Station.	1 Central Station.
Ordinary 500 Volt Distribution.	2 Rotary Transformers 1500 Volts Transmission.	4 Rotary Transformers 1500 Volts Transmission.	6 Rotary Transformers 1500 Volt Transmission.
Copper = 100.	Copper = 48.7	Copper = 23.3.	Copper = 13.9.

The ideal system of transmission, however, is an alternating current on the feeders at high pressure, stationary transformers at regular intervals between feeder and trolley lines, reducing the current to 500 volts, and an alternating street railway motor on the cars. But the last is not yet forthcoming, and while it is possible to operate induction motors successfully, their tendency to synchronism renders them exceedingly low in efficiency when run at varying speeds and the controlling devices become very complex.

46 Ton Train — 2 Cars — 2-100 H.P. Motors. Each Car Empty (exclusive of equipment) - 14 Tons. THE WALKER MANUFACTURING CO., CLEVELAND, O.					
% Grade	Speed Miles per Hour	Total Current	H.P.	Efficiency	Horizontal Force (lbs.)
0	40.5	136	75.8	83.3	700
½	34.8	169	97.2	85.7	1052
1	30.7	205	119.0	86.7	1452
1½	28.0	240	139.4	86.9	1860
2	26.0	273	159.0	87.0	2280
2½	24.4	307	177.0	86.4	2710
3	23.2	341	195.0	85.8	3166
3½	22.2	374	214.0	85.3	3600
4	21.2	408	231.0	84.6	4074
4½	20.4	438	246.0	83.8	4510
5	19.6	470	2600	82.8	5000

TABLE II.—100 H. P. MOTOR PERFORMANCE.

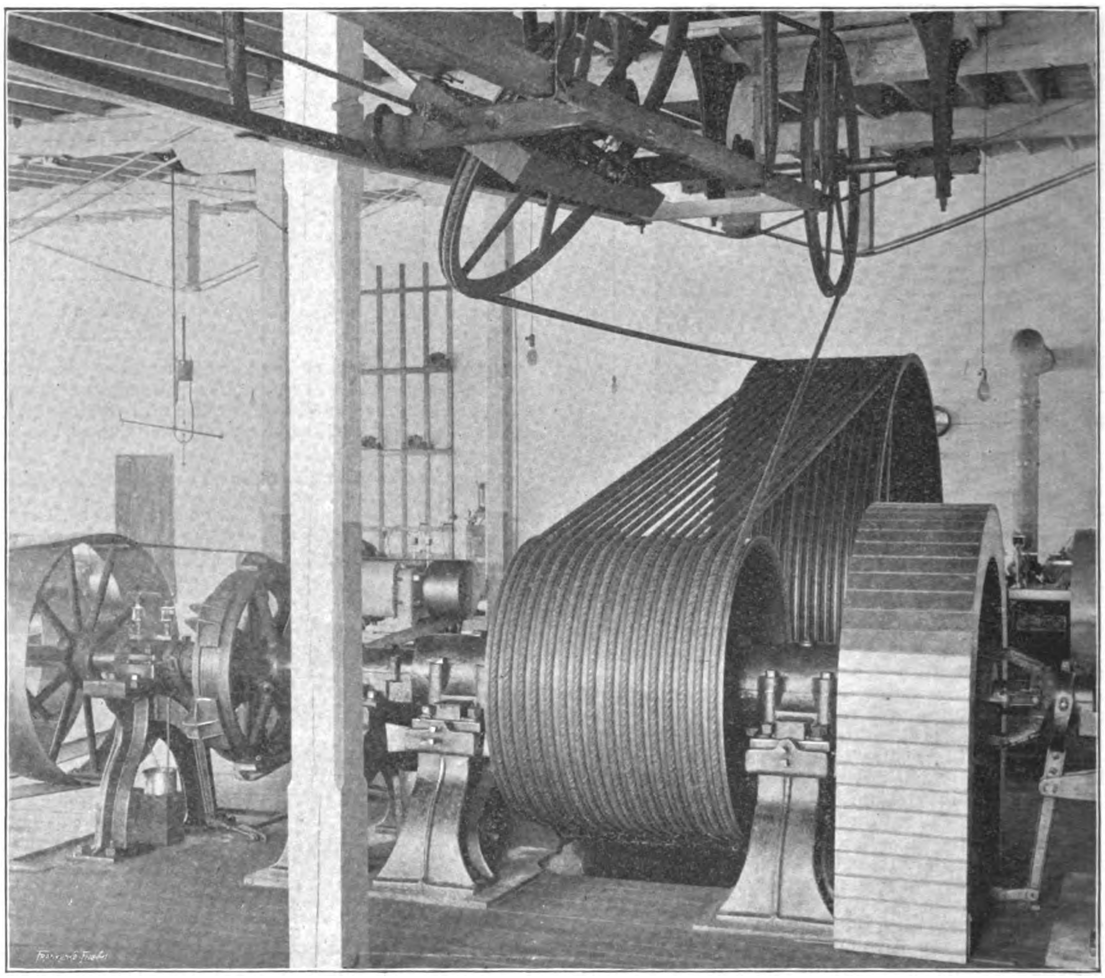
THE WESTERN TELEPHONE CONSTRUCTION CO., of Chicago, through Mr. Keelyn, has started a movement for an independent association of opposition telephone companies, with the object of acting in unison against Bell competition and legal measures.

ROPE DRIVING IN POWER PLANT OF THE MOLINE E. L. & P. CO.

The accompanying engraving illustrates a rope drive recently installed in the plant of the Moline, Ill., Electric Light and Power Co. Two years ago it was apparent that, owing to the partial failure of the water power and the increased demand for current for street railway and lighting service, a 500 H. P. engine had to be added to the plant. Extensions to the shafting were made, new machines added and a Buckeye engine of 500 H. P. capacity, installed. The vital point involved in placing the engine was the extremely short centres which had to be observed in the main drive from the fly-wheel. Belting was out of the question and rope transmission came in for much consideration. The result was finally the adoption of the English system of rope driving.

This system, however, proved unsatisfactory and has now been replaced by the American Rope Transmission System of the Dodge Manufacturing Co.

The details of this connection with the American system are as follows: Diameter of fly-wheel, eleven feet; diameter of driven or line shaft sheave, four feet; distance between centres, eleven and one-half feet, requiring sixteen wraps of one and one-quarter inch three-strand cotton-thread rope. The results obtained under these conditions are all that could be desired and are under no disadvantage as to short centres.



ENGINE ROOM, PEOPLE'S ELECTRIC LIGHT AND POWER PLANT, MOLINE, ILL., SHOWING ROPE TRANSMISSION.

ELECTRIC AND GAS COMBINATION IN SEATTLE, WASH.

THE UNION ELECTRIC LIGHT COMPANY, of Seattle, has been in existence three years, during which time the Company has been in active competition with a large gas company there, which was first in the field. On March 1 a new company, known as the Union Illuminating Co., was formed, which leased the properties of the two companies, the Seattle Gas & Electric Light Co. and the Union Illuminating Co. This is one of the instances where the electric company has succeeded in besting the gas company,—if there be any virtue in that—the Union Electric Co. being the controlling party in the new combination. The arc light station which was formerly run by the gas company, is to be closed down, and the offices have been consolidated in the rooms formerly occupied by the Union Electric Co. Dr. E. C. Kilbourne, Gen. Mngr. of the Union Electric Co., continues Gen. Mngr. of the Union Illuminating Co. Mr. A. L. Hawley, formerly Asst. Mngr. of the Union Electric Co., is now Superintendent and Purchasing Agent of the new company.

POWER AND LIGHT FOR A VERMONT MARBLE QUARRY.

The Vermont Marble Company has just closed a contract with the General Electric Company for the erection in Proctor, Vt., of an electric light and power plant. The power for the two dynamos of about 200 h. p. will be furnished by water wheel. A number of the gadders and cutting machines in the main quarry will be operated by electricity, also five hoisting powers, pumps, etc., connected with the quarry. The machinery in the machine and carpenter shops will be run by electricity and in the store the elevator and coffee mills will be operated by it. The mills, shops, barns, stores and offices of the company will be supplied with about 700 incandescent lamps which will be of varying candle power, 16, 24, and 32, and two arc lights of 2,000 candle power each will be located at the quarry, while 10 more of them will be made useful in lighting up the streets of the village. It is expected that the building of the lines and of the power house will be expedited to such an extent that the test of the system can be made some time in July.

AN ELECTROZONE PLANT FOR PHILADELPHIA.

THE Philadelphia Board of Health has determined to install an electrical plant for the manufacture of electrozone according to Mr. A. E. Woolf's process. The plant with a capacity of 1,000 gallons per hour will be placed in the basement of the Municipal Building, and the product will be used for sprinkling the streets and for general disinfecting purposes.

SOCIETY AND CLUB NOTES.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Dr. Louis Duncan.

The Annual Meeting of the Institute for the reception of the yearly reports, and election of officers was held at 12 West 31st street, May 21. The Council reported a membership of 944, showing a net gain of 144 members for the year ending April 30th, 1895.

The count of letter ballots for officers for the ensuing year gave the following result:

President, Dr. Louis Duncan, of Baltimore, Md.; *Vice-Presidents*, Dr. Michael I. Pupin, of New York City; W. F. C. Hasson, of San Francisco, Cal.; Angus S. Hibbard, of Chicago, Ill. *Managers*, Carl Hering, of Philadelphia, Pa.; Bion J. Arnold, of Chicago, Ill.; Charles F. Scott, of Pittsburg, Pa.; Dr. Cary T. Hutchinson, of New York City. *Treasurer*, George A. Hamilton, of New York City.

The discussion of Prof. Anthony's paper on "Underwriters Rules" read April 17th was resumed, and opened by Prof. W. L. Puffer of Boston.

At the meeting of Council in the afternoon the following Associate Members were elected:

William C. Andrews, Student Electrical Engineering, Columbia College; residence, 162 Hicks St., Brooklyn, N. Y. Clare F. Beames, Electrical Engineer, Gen'l Elec. Co., Schenectady, N. Y.; residence, 68 W. 131st St., N. Y. City. Myron E. Canfield, Western Electric Co.; residence, 404 W. 44th St., N. Y. City. John Thomas Dewar, Electrical Expert, Western Electric Co.; residence, 33 Rue Bouewijns, Antwerp, Belgium. William David Gharky, Sup't Underground Cable Construction and Maintenance, Philadelphia Traction Co.; residence, Windsor Hotel, Philadelphia, Pa. Henry Banks Henderson, Graduate Student Cornell University; residence, 76 E. Buffalo St., Ithaca, N. Y. Sydney Hogentoren, Electrical Expert, The Varley Duplex Magnet Co.; residence, 1617 Avenue B, N. Y. City. Theodore K. Jackson, Assistant to Sup't, Hyde Park Elec. Light and Power Co.; residence, 137 56th St., Chicago, Ill. Frank W. Roller, Electrical Engineer, with J. C. Machado, 203 Broadway, N. Y.; residence, 515 Clinton Avenue, Brooklyn, N. Y. Alexander B. Simpson, Estimator, N. Y. Electrical Equipment Co., N. Y. City; residence, 125 2nd Place, Brooklyn, N. Y. Norman T. Wilcox, Manager and Electrician, Seneca Light and Power Co., Seneca Falls, N. Y.

The following Associate Members were transferred to Full Membership:

Romaine Callender, Electrician, Decker Building, New York City. J. Day Flack, Electrical Engineer, 252 West 85th St., New York City. F. R. Colvin, President, Interior Telephone Co., 203 Broadway. New York City. Russell Robb, with Stone & Webster, 4 Post Office Square, Boston. V. M. Berthold, American Bell Telephone, 125 Milk St., Boston. Herbert Lloyd, General Manager, Electrical Engineer and Chemist, The Electric Storage Battery Co., Drexel Building, Philadelphia, Pa. Harry Hartwell Blades, General Superintendent, The Detroit Motor Co., 1343 Cass Avenue, Detroit, Mich.

The Council decided that the General Meeting at Niagara Falls should be held on June 25th to 28th inclusive.

The reports of the council, secretary and treasurer showed the Institute to be in excellent condition. It has a total of 944 members in good standing, or a net gain of 144 in the year. The receipts during the year were $10,617, about balancing the expenditures. The Congress book was issued in an edition of 1000 copies at a cost of $1,517. This has all been recouped except $180, and there is a stock of 480 books on hand, for which there is a steady demand.

DINNER OF THE MORSE CLUB.

The Morse Club had its first annual dinner at Jaeger's, New York, on May 24. A picture of Prof. Morse hung back of the guest's table, and underneath were the words "What hath God wrought?"

President Milan R. Hults of Bridgeport, Conn., presided. At his right sat Edward Lind Morse of Lakewood, N. J., youngest son of Prof. Morse.

Among the prominent telegraph men present were Thomas F. Clarke, A. B. Chandler, Charles A. Tinker, George G. Ward, W. H. Baker, and E. C. Platt. The Club is to decorate the Morse Statue in Central Park every year, and in other ways also to cherish the memory of the great inventor.

LITERATURE.

A Treatise on the Measurement of Electrical Resistance. By W. A. Price, M. A., A. M. I. C. E. New York. Macmillan & Co. Cloth. 8vo., illus., 199 pp. Price $3.75.

This is an admirable discussion of an important subject, by one whose special work for many years has been the construction of resistances and of apparatus for their testing. Mr. Price brings together a large amount of valuable information on the various details, beginning with the materials employed, and passing on through the methods of construction; switches, commutators, bridges, etc. There are also several chapters on methods of measuring low and high resistances, while a series of appendices are devoted chiefly to the mathematical theory involved in bridge and battery measurements. Mr. Price has carefully consulted his authorities and has added a great deal of useful data of his own.

The Brush Arc Light System. Chart and Handbook. By H. C. Reagan, Jr. New York. Norman W. Henley & Co. Cloth. 8vo. Illus. 48 pp. Price, $1.

Mr. Reagan has written a very compact and useful little book on the Brush system. It not only explains every part clearly and fully, but shows how to handle the apparatus under both normal and abnormal conditions. A pocket in the cover contains disc a handy and highly ingenious revolvable celluloid chart. The is supposed to be a Brush armature, and the coils can be swung around into any position. Other celluloid strips represent brushes, to whose terminals run the leads of the external circuit, while the inner ends rest on the commutator segments. It may be remembered that Mr. H. A. Foster has given a similiar exposition of the Thomson-Houston machine in Crocker & Wheeler's book on the dynamo. Such practical treatment is every way desirable and helpful.

Nikola Tesla's Untersuchungen ueber Mehrphasenströme und ueber Wechselströme hoher Spannung und Frequenz. By Thomas Commerford Martin. Authorized German edition, Translated by H. Maser. Halle, a. S.: 1895. Wilhelm Knapp. 508 pages, 6½ x 9½ inches. Paper.

MR. MARTIN'S book is too well known to English readers to require any review at our hands, but it is interesting to note that the demand for information relating to Mr. Tesla's work has so soon called for a German edition. The translator, Herr Maser, has done the work in an admirable manner, so that German readers are now placed on the same footing as English in the facilities at their command for following the researches of Mr. Tesla. The book is admirably printed in good type on good paper, and the cuts are the same as in the American editions.

PERSONAL.

MR. W. L. CLARK, formerly with the engineering department of the Edison General Electric Co., and more recently with the New York Edison Illuminating Co. has accepted the position of general manager of the newly organized Asbury Park Electric Co., which has a plant of the Fort Wayne system with 5000 incandescent lights and 250 Wood arcs.

MR. L. B. PEMBERTON, of Los Angeles, Cal., has published a neat little volume of verse entitled "Sappho and Other Songs." Although Mr. Pemberton practices the prosaic profession of an electrical engineer, he has not allowed the hum of the dynamo to drown in his ear the rhythm of stately and pure verse. The climate and scenery of Southern California do much to recall those of Greece, and it is evident that Mr. Pemberton has, partly by temperament and partly from environment, caught not a little of the fine old classic spirit. His poems have movement, music, and imagery in abundance; and we hope he will always find leisure for the indulgence of his gift. Will he not give us a few poems embodying, before it passes away, the quaint, subtle charm that the Spanish occupation has left on the enchanted domain of Missions and conquistadors?

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 21, 1895.

Accumulators:—

Automatic Time Switch for Storage Batteries, W. Biddle, Brooklyn, N. Y., 539,500. Filed May 18, 1894.
Uses two secondary batteries and a switch that is moved by clockwork to connect one battery to the lamps and the other to the dynamo simultaneously, and reverse the connections periodically.

Alarms and Signals:—

Electric Bell, F. G. Ingersoll, New York, 539,431. Filed Oct. 26, 1894.
An electric bell that will give heavy strokes slowly and repeatedly, while the circuit is kept closed at the transmitting key or button.
Signal Box Attachment, A. Gruner, San Francisco, Cal., 539,511. Filed July 28, 1894.
Locks the operating lever, after being set, so that the box is inoperative until such time as it is desired to transmit an alarm or signal, when the same may be released automatically by the opening or closing of an electric circuit.
Electric Railway Signal, H. V. & A. C. Miller, Aurora, Ill., 539,529. Filed Jan. 5, 1895.
Electrical Low Water Indicator for Boilers, C. D. Tisdale, Boston, Mass., 539,559. Filed April 19, 1894.
A float placed within the water gauge tube, forms an electrical connection between two contact wires extending up into the tube, and sounds an electric alarm at low water.
Electric Safety System for Railway Drawbridges, E. Deming, Brooklyn, N. Y., 539,576.
Multiple Signal Transmitter, B. J. Noyes, Boston, Mass., 539,701. Filed Nov. 4, 1890.
Improvement on same inventor's patent No. 344,467.

Cut-Outs, Switches and Rheostats:—

Electric Cut-Out, J. R. Hersh, Denver, Col., 539,583. Filed Jan. 11, 1895.
A cut-out comprising a series of fusible links, so that when one is fused another can be quickly moved in its place.
Rheostat Face Plate with Supplemental Rheostat, F. Kramer & M. Kruger, Chicago, Ill., 539,585. Filed Sept. 19, 1894.
Cut-Out Block, F. A. Chapman, Philadelphia, Pa., 539,725. Filed Feb. 5, 1895.
Means for effecting a connection between the main wires and the plug, and tap-wires and the fuse-wires, the connection being such as to permit of currents of high potential being passed through the plug without any danger of sparking.
Rheostat Switch for Electric Motors, F. B. Rae, Detroit, Mich., 539,778. Filed July 6, 1894.
Automatically introduces or removes artificial resistance in the armature circuit of the motor just in proportion as it is required by the reduction or increase of the counter electro-motive force of the armature when the current is turned on or off.

Distribution:

System of Electrical Distribution, E. W. Rice, Jr., Swampscott, Mass., 539,446. Filed May 24, 1893.
Provides means whereby sections of the circuit may be cut out, when necessary, so that repairs can be made without danger of injury by shock to the workmen.
System of Electrical Distribution, C. P. Steinmetz, Schenectady, N. Y., 539,450. Filed Dec. 20, 1894.
For description see p. 486, this issue.

Dynamos and Motors:—

Regulating Alternating Current Induction Motors, A. H. Armstrong, New York, 539,404. Filed Dec. 5, 1894.
Relates to a method of regulating mechanism driven by alternating current motors of the induction type, which consists in coupling the motors in tandem for one rate of speed, and changing them to multiple for a higher rate of speed through a number intermediate steps.
Carbon Brush, E. Thomson, Swampscott, Mass., 539,453. Filed Feb. 6, 1895.
For description see p. 485, this issue.
Carbon Brush, E. Thomson, Swampscott, Mass., 539,454. Filed Feb. 6, 1895.
A commutator brush made of filamentary carbon coated with metal, and mounted in a casing for strengthening it.

Electro-medical Apparatus:—

Electrotherapeutical Body Wear, W. J. Newton, H. J. Purbrook and H. De C. Hudson, Wellington, N. Z., 539,484. Filed Aug. 31, 1894.
Electrical Instrument for Medical Purposes, B. Y. Boyd, Wichita, Kan., 539,501. Filed Aug. 27, 1894.

Lamps and Appurtenances:—

Cut-Out for Arc Lamps, P. Kirkegaard, Brooklyn, N. Y., 539,692. Filed Nov. 9, 1894.
Provides a cut-out which acts positively and which is not subject to sparking when the circuit is interrupted.

Measurement:—

Electric Meter, C. P. Steinmetz, Schenectady, N. Y., 539,452. Filed Feb. 19 1895.
Relates to an electric meter designed for the use on monocyclic circuits.

Miscellaneous:—

Electric Treasure Guard, R. A. Habersham, Portland, Ore., 539,737. Filed Jan. 3, 1895.
The object is to provide a simple and efficient means for the protection of those engaged in handling money and other valuables against robbery by violence. An unauthorized person handling the box containing the valuables receives a dangerous shock.

Railways and Appliances:—

Conduit System for Electric Railways, W. H. Cotton, St. Louis Mo., 539,418. Filed Aug. 25, 1894.
Details of construction.
Trolley for Electric Railways, J. W. Hoag, Newark, N. J., 539,516. Filed Jan. 19, 1895.
The trolley wheel can travel along the bottom of the wire with sufficient side movement to maintain contact with imperfect alignment of the wire.
Electrical Bond Clamp, A. Green, Rochester, Pa., 539,616. Filed Aug. 27, 1894.
A clamp for rail bonds.
Base for Trolley Poles, A. Green, Rochester, N. Y., 539,681. Filed Sept. 5, 1894.
Details of construction.
System for Controllers for Electric Motor Cars, C. L. Coombs, Washington, D. C., 539,786. Filed Nov. 12, 1894.
The switch which controls the current passing to the motor is used at the same time to control the current passing to other portions of the car, such, for instance, as the braking mechanism.

Telegraphs:—

Telegraph Relay, A. Gruner, San Francisco, Cal., 539,512. Filed July 28, 1894.
Consists in so connecting the coils that the battery for actuating the circuit will be located therebetween, instead of to one side thereof, and connected to the ends of both coils, the opposite ends being connected to the telegraphic or signal circuit.

Telephones:—

Microphone, E. J. P. Mercadier & J. M. Anizan, Paris, France, 539,437. Filed June 3. 1893. See p. 490, this issue.
Transmitter-Diaphragm, G. A. Nellis & F. S. Weisser, Allegheny, Pa., 539,686. Filed Mch. 11, 1895. For description see p. 492, this issue.
Telephone Call, F. J. Troll, Washington, D. C., 539,712. Filed Sept. 22, 1894.
Relates to that form of telephone call in which the revolving armature is rotated by a flexible metal tape on a drum, which tape when drawn out turns the armature in one direction, and is rewound again by the tension of a coil spring.

LEGAL NOTES.

THOMSON-HOUSTON ELECTRIC CO. vs. WINCHESTER AVE. STREET R. R. CO.—TROLLEY LITIGATION.

The case of the Thomson-Houston Electric Company against the Winchester Avenue Street Railroad Company of this city has begun at New Haven, before the Circuit Court. It is really a suit between the Westinghouse and General Electric Companies. The features of the "under running trolley" are in litigation, the Van Depoele and other patents being involved.

THE BERGMANN SOCKET PATENTS.

In regard to our note last week on the Bergmann socket suit, Howson & Howson, the counsel for the Bryant Electric Co., inform us that the complainnaint's (Edison Electric Light Co.'s) notice of motion for injunction included also the Bergmann Rubber Ring patent No. 293,552; as well as No. 257,277. The defence as to the rubber ring, however, was such convincing proof that the complainant did not own it, that the motion as to that patent was withdrawn.

OBITUARY.

ARTHUR MELLEN WELLINGTON.

We regret to record the death of a talented and esteemed colaborer in the field of technical journalism—Mr. A. M. Wellington, one of the owners and editors of the *Engineering News*. He was born in 1847 in New England, early devoted himself to civil engineering, and from 1884 up to the time of his death was actively engaged in literary work, first upon the *Railroad Gazette* and later upon the *News*. But he contrived to find leisure for outside work, and is well known by more than one book. His "Economic Theory of the Location of Railways" stands to-day as a masterpiece. Mr. Wellington, moreover, was called upon from time to time to act as consulting engineer in various railway enterprises, such as the Canadian Pacific, Nicaragua Canal, and the Boston Transit subways. Of late he had been enthusiastically absorbed in the subject of thermo dynamics, and believed he had hit upon a type of engine with a much smaller percentage of loss than the best existing types.

Mr. Wellington was an active member of the American Societies of Civil and Mechanical Engineers; of the Engineers' Club, and of the Canadian Society of Civil Engineers.

Speaking of his admirable work as a journalist, and of his methods, the *Engineering News* says:—"He combined in wonderful measure the two valuable qualities of originality and industry, and it is worth noting, by the way, that such a combination is uncommon; the man of genius is apt to shirk the hard work. Mr. Wellington's originality was conspicuous. If he edited a letter for publication in the correspondence column, it was sure to suggest some idea to him, which he would add at the end as editorial comment. If he prepared a Note for the "Engineering News" page, it was seldom a colorless recital. Some piquant criticism would be thrown in. His industry was measureless; he never dropped a proposed scheme merely on account of the amount of labor involved. If an editorial involving a great amount of research or the preparation of lengthy tables suggested itself to him, the labor involved was never a reason for abandoning it. He seemed to regard it rather as a sort of challenge and undertook it with the greater relish. It must be said, however, that one good reason for the courage with which he undertook what to others would have been Herculean tasks was the lightning speed at which his mind worked. His grasp of a question was instantaneous, and his decision, when a question was presented to him, was given almost as soon as the words were out of the questioner's mouth."

FINANCIAL.

HARDENING PRICES.

It cannot be said that the past week has witnessed any material change in the prices of stocks and bonds. Activity and speculation have been more particularly evident in grain and cotton, wheat advancing many cents. But it would appear on cold scrutiny of the facts, that corn and wheat are higher, more because of short supply than of any real shortness feared, in the coming crop.

Western Union closed last week as it closed the week before, at 92⅜. General Electric closed at 33⅛ as against 34¼ in the previous week; but in neither stock was the dealing large. In Boston, Bell Telephone went up to 202 on the strength of the Berliner decision. Commercial Cable stands at 150. Reports from all the centres show lighting and street railway securities to be in strong demand.

REPORTS OF COMPANIES.

PATENTS AND PLANT OF THE WADDELL-ENTZ ELEC. CO. SOLD IN BRIDGEPORT.

At an auction sale on the steps of the County Court House in Bridgeport, Conn., May 22, by order of the Superior Court, Percival Knauth of New York bought the plant and stock of the Waddell-Entz Electric Company. The effects disposed of consisted of letters patent in France, Germany, Canada, and Belgium on the alkali storage battery which the company has been trying to perfect, also the tools and machinery at their plant in Bridgeport, and the Second Avenue street car line equipment, complete, at One Hundred and Twenty-seventh Street and Second Avenue, in this city. The price paid for the entire lot was $60,000.

AFFAIRS OF S. W. RUSHMORE.

A meeting of the creditors of Mr. S. W. Rushmore held recently decided to give him until December 1, 1896, to get his indebtedness liquidated, he proposing from August 1 next to apply all net earnings in reduction of claims against him on merchandise account. His assets are $8,244 and his liabilities $8,975. Certain claims for borrowed money have been secured by liens on machinery and material, but these secured creditors are willing to subordinate their claims to those of the general creditors in the event of an acquiescence in the plan to grant time.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NOT A PIGEON PIE EXACTLY, BUT—

Last week the advertising pages of THE ELECTRICAL ENGINEER contained a mysterious full page announcement, the chief feature of which was a box the cover of which would be lifted this week. Conjecture has been rife as to what was meant, and what the box might contain—whether ice cream, oyster stew, strawberry shortcake, succulent caramel, or baked pork and beans. This week the mystery is out. The box contains a Perkins Pie, and each portion of the pie is neatly exposed to view by the lifting of the top crust. Not only is the display attractive, but there is no monopoly about it. It is not like the pie carried off into a Wall street corner by Mr. John Horner, for his sole delectation; nor is it smuggled surreptitiously away by a Pickwickian fat boy yearning only for an unlimited share of his favorite dish. On the contrary, everybody is invited to send up his plate for a slice, and in order that nobody may be disappointed, the Perkins Pie Factory is now in full blast making this choice and attractive article of electrical diet.

DEMAND FOR ROEBLING TROLLEY WIRE.

Rapid progress is being made with the electrical equipment of the Mount Holly branch of the Pennsylvania and the Nantasket Beach branch of the New York, New Haven & Hartford railroads. On the Pennsylvania road regular 00 B. & S. gauge hard drawn trolley wire and stranded weatherproof feeder will be used, but the Nantasket Beach branch is to be equipped with a copper trolley wire of peculiar shape, to give a large surface of contact to the trolley and a convenient mode of suspension. All the wire for both roads is being made by John A. Roebling's Sons Co., who are said to be about the only concern which has been successful with odd shapes of copper wire in long lengths for this purpose.

SHAWMUT FUSE WIRE COMPANY.

One of the peculiar features of electrical industries is the ease with which a manufacture will drift into a new channel, which will presently absorb more attention and capital than the original industry. A maker of porcelain rosettes and other electrical attachments some time ago suddenly developed into a manufacturer of white porcelain ware, and many other similar evolutions could be mentioned. One of these is now to hand in the case of the Shawmut Fuse Wire Company, of Boston, Mass. This company for many years confined itself to the making of fuse wire, but presently it found that the efficiency of its well known wire could excellently be brought out by fittings of its own, based on standard productions, which could be relied on to possess the best requisites for the purpose. It has now published a catalogue giving samples and prices of its cleat rosettes, rosettes for concealed, moulding, and combination work; fusible rosettes, wall sockets, receptacles; cut-outs, main and branch blocks, switches, junction and feeder boxes, and a comprehensive line of kindred appliances.

ACTIVITY AT THE BALL ENGINE WORKS.

The Works of the Ball Engine Co., Erie, Pa., present a scene of activity to a visitor, the erecting floors being crowded with engines in process of construction. Especially noticeable by their appearance among the many engines, are three 175 H. P. engines arranged for direct connection to Mather dynamos, and which are to go to the new Library of Congress, Washington, D. C. These engines are painted a dazzling white according to the instructions of the Government, and with their polished brass fittings, present a handsome and massive appearance. Among other engines seen in process of erection are 2–125 H. P. tandem compounds for the Norfolk & Ocean View R. R., Norfolk, Va., 1–300 H. P. tandem compound railway engine for the Rock Creek Railway Co., Washington, D. C., 1–400 H. P. vertical cross compound engine for the Camden Horse Railroad, Camden, N. J., 2–160 H. P. tandem compounds for the Salamanca Water Works, Salamanca, N. Y., 1–175 H. P. for the Suburban Traction Co., Orange, N. J., 1–100 H. P. vertical for Detroit *Free Press*, Detroit, Mich.; besides many others, large, medium sized and small.

ELECTRIC LIGHT AND GAS SUPPLIES WANTED.

THE UNION ILLUMINATING CO., of Seattle, Wash., will be in the market for a stock of supplies, both electrical and gas, and gas stoves, during June and July. Mr. A. L Hawley, the company's purchasing agent, will be pleased to receive catalogues, etc., at the home office, Seattle, up to June 1. After that day they should be addressed to him at No. 1255 Wabash Ave., Chicago, Ill.

BERLIN IRON BRIDGE CO.'S WORK.

The steel frame for the extension to Gardes Hotel, New Haven, Conn., has been completed by the Berlin Iron Bridge Co. The new boiler house for the Piercefield Paper & Mining Co., at Piercefield Falls, N. Y., has been completed by the same builders, who are also putting up a new car barn for the Wilkes Barre & Wyoming Valley Traction Co., at Wilkes Barre, Penn. The building will be 78′ width and 228′ in length.

METROPOLITAN ELECTRIC CO.

The "Portable Fire Hose Bridge," for which the Metropolitan Electric Company, 186 and 188 Fifth Ave., Chicago, are General Agents, is meeting with the approval of the electric street railways. This Company has already received orders from several roads and is constantly receiving inquiries.

The Metropolitan Electric Company, report a very good demand for their well known P. & B. products. Their numerous street railway customers express themselves as being well satisfied with results obtained from the use of P. & B. tape and compounds.

The Metropolitan Company wish also to inform the trade that they are now in position to fill orders from stock for the well and favorably known "Solar" arc lamp for incandescent circuits.

NEW MACHINE SHOP FOR THE GENERAL ELECTRIC COMPANY AT SCHENECTADY, N. Y.

Many firms are bidding for the erection of the new machine shop shortly to be put up at Schenectady by the General Electric Company. The building will be of the same form as that erected last summer by the Schenectady Locomotive Works, but of double the size. It will be of brick, two stories high, and absolutely fire proof, the floors being of iron, set in concrete cement. It will be 360 feet long by 80 feet wide. Its estimated cost is $175,000, of which nearly if not quite $100,000 will be for iron work. The building will be on the west side of the works, and it will form an important addition to the resources of the company.

AN ASSOCIATION OF INDEPENDENT TELEPHONE COMPANIES.

AT the invitation of Mr. J. E. Keelyn, President of the Western Telephone Construction Co., a representative gathering of telephone men assembled in Chicago for the purpose of forming a national organization for the mutual protection of companies engaged in the telephone business outside of the American Bell Co. The organization of the Association was completed by the election of the following officers: President, J. E. Keelyn of the Western Telephone Construction Co.; vice-president, Mr. Johnson, of the Viaduct Manufacturing Co.; secretary, Mr. Paul Bossart.

Among the companies represented at the meeting were the following: Viaduct Manufacturing Co., Baltimore; the Phœnix Telephone Co., of Indianapolis; the Utica (N. Y.) Fire Alarm Telegraph Co.; Manhattan Electric Supply Co., of New York; the National Telephone Co., of Kokomo; the Western Telephone Construction Co., of Chicago; the Standard Telephone Co., of New York; the Keystone Telephone Co.; the Pittsburgh Telephone Co., of Pittsburgh. The executive committee consists of a representative from each company.

NEW YORK NOTES.

H. B. COHO & Co., 208 Broadway, request us to state that they are not wiring contractors nor consulting engineers, but dealers in first class electrical machinery, to which they devote their whole time.

MR. J. H. RHOTEHAMEL, president of the Columbia Incandescent Lamp Co. was again in the East last week, visiting New York. The eastern agencies of the Columbia lamp are daily becoming of more importance, and Mr. Rhotehamel's long insistence on high quality of product is reaping its reward.

MR. C. E. BIBBER, of the Crefeld Electrical Works, of Boston, was recently a visitor to this office, and spoke very encouragingly of the great increase in the volume of their business. They are receiving large orders for magnet wire from the leading electrical manufacturers, and in addition are about ready to put some other special wires on the market.

THE GLOBE ELECTRIC CONSTRUCTION CO., 29 West 26th street, has a good deal of new work in hand, and finds the prospect bright. P. M. Mowrey is the vice president and general manager; H. C. McKenzie, treasurer; and John G. Phillips, secretary. These gentlemen are well known to the trade and profession. The company does house wiring, builds isolated plants, and undertakes construction work generally both in the city and outside.

BELLEVILLE, N. J.—Bids were received and opened May 16 at the Town Hall of the township of Belleville, for lighting the township for a term of one year with electric lights. Bids were received from the Newark Electric Light Co., the Kearney Electric Light and Power Co., and from the electric light company at Nutley, N. J. The bid of the Kearney Electric Light and Power Company was the lowest. The matter is now under consideration by the township committee. The award will be made soon.

THE STANDARD PAINT CO. of New York, not content with the great success which the name of P. & B. paint has achieved in the United States, have recently been turning their attention to foreign business and have succeeded beyond their expectation. Their business abroad is steadily increasing, and they have recently had extensive orders from their London and Paris agents, and have completed arrangements by which their goods are now being introduced into China and Japan. There have been many attempts to imitate P. & B., but this good old brand still continues in the van, and is rapidly becoming favorably known throughout the whole civilized world.

MR. CHARLES I. HILLS will sever his connection with the Columbia Incandescent Lamp Co., of St. Louis, Mo., and on June 1st will assume his duties as manager of the New York office of the Perkins Electric Switch Mfg. Co., of Hartford, Conn., with headquarters at 219 Havemeyer Building, New York. Mr. Hills has been for many years prominently before the electric trade, as identified with the incandescent lamp business, and was connected with Mr. Gates, the present manager of the Perkins Switch Co., in the old days of the Perkins Electric Lamp Co. There is no better known salesman in the field than Mr. Hills, and with his wide knowledge of the electrical trade and his extensive friendship which extends all over this country, he will undoubtedly make a valuable addition to the staff of the Perkins Switch Co., who are now ready to market their new incandescent lamp, as evidenced by their very attractive announcement amongst our advertising pages.

SOUTHERN NOTES.

THE GEORGIA ELECTRIC LIGHT CO., of Atlanta, Ga., has renewed its contract with the city for five years, arc lighting to be at the rate of $85 per lamp per year, and 75 C. P. incandescents at $35.

ELECTRICITY BUILDING at the Atlanta Exposition has been completed, and has already been availed of for one or two functions by visitors, such as the Order of Railway Conductors, for their grand ball and reception.

AUSTIN, TEX.—The Texas Electric Company has been formed, with a capital of $5,000. The officers are: C. Q. Horton, president, J. E. McGillivray, manager, and E. B. Fisher, secretary. The company is doing business in electrical supplies and construction, and the increasing exigencies of their trade have put them in the market for large quantities of construction material.

WESTERN NOTES.

MR. SAMUEL INSULL, president of the Chicago Edison Co., was a visitor to New York last week.

LOUISVILLE, KY.—The Harrison Telephone Construction Company for Kentucky and Tennessee has filed articles of incorporation at Louisville. The capital stock is placed at $100,000. The business is the construction of telephone lines and the operation of telephones, and the principal office is to be in Louisville.

THE ELECTRIC APPLIANCE COMPANY report having just closed agency arrangements for the exclusive sale in the West of the celebrated "Upton" arc lamps for direct and alternating constant potential circuits and regular series arc work. The lamp is extremely simple in construction and correspondingly low in price, and is meeting with favor.

ST. LOUIS, MO.—An ordinance has been introduced in the City Council, granting for a period of 50 years to J. A. Schultz, Thomas J. Ward, August A. Busch, Charles F. Joy, M. Greenwood, Jr., E. W. Stamm, Joseph M. O'Shea, Andrew Haley and T. J. Hennessey, the right to erect, maintain and operate a telephone system in St. Louis.

THE TACOMA, WASH., GAS & ELECTRIC LIGHT CO., has purchased the gas works of the Tacoma Light and Water Co. and the electric plant of the Commercial Electric Light & Power Co. The owners of the purchasing company are John F. Dillon of New York, Edmund Seymour and Chas. B. Hurley, the two last named being respectively president and general manager and treasurer. W. G. Gaston is secretary.

NEW ENGLAND NOTES.

THE BRADBURY-STONE STORAGE CO., of Lowell, Mass., have recently installed at the residence of Mr. W. E. C. Eustis, Milton, Mass., a storage battery plant of 1,000 ampere hours capacity, of their very latest type, in lead-lined tanks. The plant is operated by windmill, and is the second largest installation of this kind in America.

THE PERKINS ELECTRIC SWITCH MFG. CO. as will be seen from their original and attractive advertisement in this issue have a new incandescent lamp on the market, with all the necessary appurtenances. A great deal is claimed for this lamp, and the Company may be depended upon to do their best to justify every expectation.

THE CREFELD ELECTRICAL WORKS, of 620 Atlantic Avenue, Boston, are meeting with large success, as manufacturers of very high class magnet wires. They manufacture the very finest wire as well as the heavier sizes, and make a specialty of only having one length of wire on a spool. The joints in the copper are particularly well taken care of and smoothed down to the regular size of the wire, so that it is impossible to tell where they occur.

THE EDDY ELECTRIC MANUFACTURING CO., of Windsor, Conn., are beginning to feel the improvement in trade, and have now a large amount of work on hand. Recently they secured the order for the complete electric equipment of the new foundry building which the Sessions Foundry Co., at Bristol, Conn. This order comprises two 60 K. W. power generators, two 20 K. W. lighting generators, and five 25 horse power motors, to be distributed over various parts of the building.

MR. HENRY F. KELLOGG, for some years connected with the Whitney Electrical Instrument Co., of Penacook, N. H., has recently become connected with the firm of W. B. Southgate & Co., of 146 Franklin St., Boston. This enterprising young concern are agents for a number of well known electrical specialties, and will also act as agents for the Whitney instruments, which now enjoy a well earned reputation. Mr. Kellogg is well known from Maine to California, and in this new connection will be sure to meet with the same success as before.

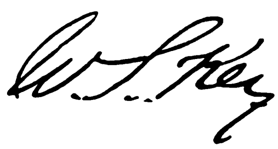
☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. JUNE 5, 1895. No. 370.

THE BOSTON NEW PUBLIC LIBRARY.

BY



I.—INTRODUCTORY.

THE most notable event of recent occurence in the city of Boston and one destined to figure prominently in its history, was the opening of its new Public Library, one of the most beautiful and perfectly equipped institutions of its kind in the world.

Architecturally considered the building is a distinct triumph. Although in general design suggested by the library of St. Genevieve in Paris, it is essentially a modern building in every respect, many new and original ideas having been worked out and now being in satisfactory operation. Artistically it offers a combination almost unknown in America. Against a background of finest architectural achievement are placed the best works of the best sculptors, painters and decorators of the present day ; while here and there are scattered some rare antiques which remind one of the old masters.

But not as "a thing of beauty" is this building alone destined to become famous and "a joy forever." In the completeness of its working equipment it is unique. It would be beyond the scope and character of this article to go more fully into a detailed description of its manifold architectural and artistic beauties than we have already done; but it may briefly be stated that the main idea of the architects has been to produce a building in which the book racks or shelves shall be removed from the main hall or delivery room, without hindrance to the promptness and efficiency of delivery.

Coming, then, to those features of this famous institution, most likely to be of interest to your readers, we proceed to a description of the engineering department, prefacing what we shall describe, by saying that for securing the comfort and convenience of its patrons, the lighting, heating and ventilation of this immense block is according to the very best and most modern engineering and electrical practice. Nor must we omit an account of the efficient mechanical manner in which the specific purpose of this library—the handling, delivery and distribution of books—has been carried out.

Electricity plays a very prominent part and has been utilized in one department for almost the first time in the history of the art. This department is the delivery and distribution of books to and from the various book stacks which are installed on different floors and at varying distances from the delivery room. The same power also conveys the borrowers' numerous application cards for books that are desired.

II.—BOOK CARRIER SERVICE.

Before proceeding to a description of the lighting system, etc., this point appears favorable for detailing the carrier system which is operated by a 10 H. P. 4-pole motor of the General Electric type. It was early in the work of building the library that the problem of book transportation presented itself for solution. In the old library, now vacated, a score or more boys were employed, their duty being to run to all parts of the building for the books required. Under the new order of things about five times more work would have to be done, which meant an army of boys, each one of whom might have to tramp from eight to ten miles every day. The impossibility, therefore, of continuing such a system was realized, and a change decided upon. The Lamson Store Service Co., of Boston, were called upon to design and construct a mechanical system suited to the requirements of the service. They had no data to go by, and so had to devise something entirely new, by means of which the attendants would be able to secure a book from any part of the vast building with its five acres of book shelves, and that with a minimum of time and labor. They designed a system by which an attendant on the floor has only to pick out the book wanted, put it in a railway car with a cable attachment, push it off the side switch to the main line, from whence it runs round at a rate of 500 ft. a minute, to a special elevator, which drops automatically, as soon as the car is in position, down to the delivery room, waits till the empty car rolls back, and then delivers it on a return track to the switch it started from.

For the accommodation of the hundreds of thousands

THE BOSTON NEW PUBLIC LIBRARY.

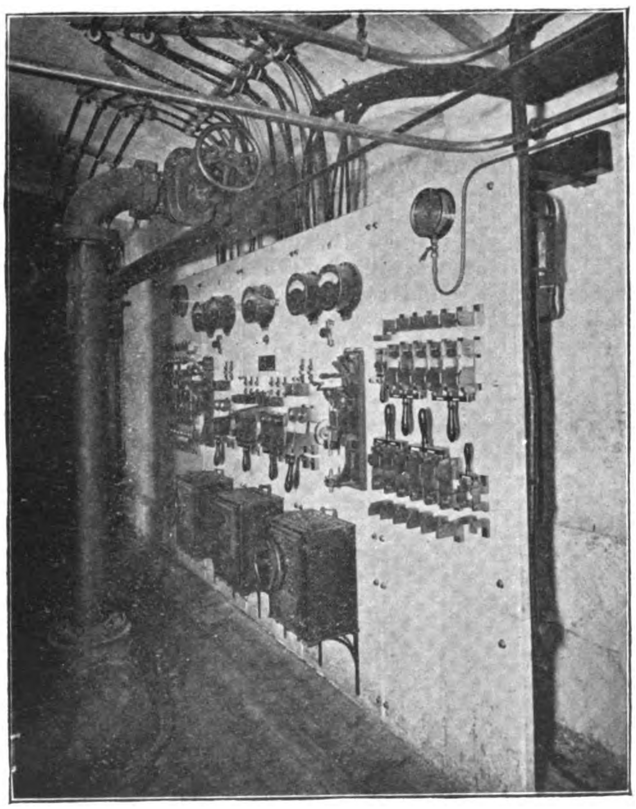
of volumes there are six stories or stacks, as they are technically called, of books. According to this arrangement, the delivery room, which opens on to the main reading room, although on the second floor front, occupies a position between the fourth and fifth stacks.

The aim of the designers was to focus all the books towards this one place, and as a first step they constructed an elevator well, long and narrow. This pierced the entire building, from basement to roof, running by the stacks and delivery room. In this they set up shafts for three elevators, one for each stack. The delivery room being between the fifth and sixth stacks, two distinct elevator

motions had to be provided for; the one from the fifth and sixth stacks going down while the ones from the first second, third and fourth went up to the room. In the basement the 10 H. P. motor has been installed to haul the elevators, which it does very satisfactorily. Then there had to be constructed a railway round the building. A miniature track with an eight inch gauge and following the lines of the interior courtyard was built. This track is over half a mile in length. The cars are made of wire and travel 500 feet a minute with 10 to 30 pounds weight of books in them. At certain points are switches working automatically, by means of which the cars are diverted to whatever part of the building or different floors they may be required. There are eighteen stations along the track, so arranged that certain cars stop at their own assigned depots and at no other. The same company constructed the pneumatic tube system by means of which cards, tickets and other missives are despatched to any desired point and returned by the same route. This apparatus is operated by the same motor.

III.—VENTILATION.

The most perfect ventilation possible has been secured throughout the library building by means of an 18 ft. Davidson fan of special construction, installed in the basement where it is run by a 50 H. P. General Electric motor.



SWITCHBOARD, BOSTON NEW PUBLIC LIBRARY.

There is also a 20 H. P. G. E. motor installed for the purpose of driving the foul air out from the building by means of a shaft provided for the purpose. The latter apparatus is installed in the roof in such a manner that it first draws the vitiated air from the different rooms and forces it into the outer air.

For ventilating purposes, the incoming air, after passing through the fan is forced through hot steam pipes, so arranged in coils that as it leaves them it passes through a series of cotton cloth bags and is thereby strained or filtered, so that by the time it reaches the various rooms it is perfectly pure and free from dust and germs of all kinds.

IV.—LIGHTING PLANT.

The lighting plant consists of two Siemens & Halske generators of 92 K. W. capacity each, at 220 volts. These generators are of the usual multipolar type, having six poles and an external armature. The current is taken direct from the armature bars, these being finished off to a commutator surface, the brushes being applied direct thereto. Each machine is of 1600-16 C. P. lamps capacity and is coupled direct to the engines.

It may be noted that the Siemens & Halske three wire system is used, the dynamos delivering current only to the outside wire of the system, the load on the two sides being balanced by an equalizer which consists of two machines coupled together, their function being to transfer any excess of load from one side of the system to the other.

V.—SWITCHBOARD.

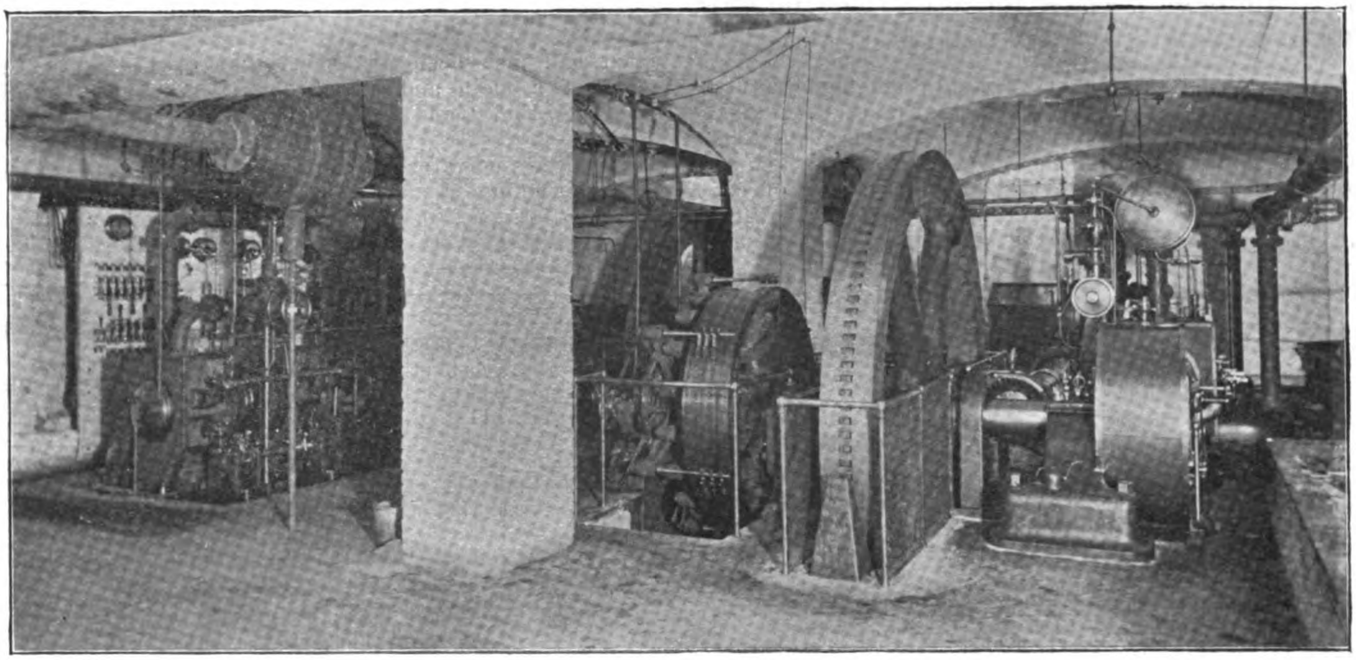
The switchboard was built and installed by the General Electric Co., and is so arranged that the lines may be operated either from the library plant, or in case of accident from the street circuit of the Edison Electric Illuminating Co. Eventually a storage battery plant will also be installed.

The switchboard carries ten three-wire double throw switches, so arranged that the lights can be run from the battery when installed, street circuits, or the library plant, or vice versa. There are also three motor switches and two Siemens & Halske carbon field switches; two field rheostats for each generator and one starting box for the equalizer; two voltmeters and three ammeters of the well known Weston types, one of the latter being a differential instrument which acts with the equalizer. The board itself is of white marble in five panels, the size over all being 12 ft. long and 7 ft. 6 in. high.

VI.—WIRING AND FIXTURES.

The General Electric Co. had the contract for wiring and fixtures, and did this work throughout. There are 3500 lights in all, divided into five groups. All cut-out boxes are of iron with slate backs. On the sides and backs are slots, so that the tubes may be brought in from any point desired. There are thirty-five of these boxes throughout the entire building. The United States rubber covered wire was used exclusively, laid in the single conduit system. Altogether over 10,000 ft. was used encased in the brass armored conduits of the Interior Conduit & Insulation Co., of New York. To meet the exigencies of this peculiar library and reading room service, floor boxes are used in connection with the table lights. They are made of composition and brass, and are let into the tesselated floor flush with the surface, and so connected that the tables can be moved without the lights being affected. There are over 200 of them in use.

There are no arc lights anywhere in the building, but in various places the incandescents are placed in clusters so as to give brilliant effects. In the main entrance hall, leading from the outer doors to the broad marble stairway are placed ten massive brass standards with lions' paws, on the top of each of which is a frosted crystal sphere enclosing six incandescent lamps. Ascending the grand stair-way are four elegant standards of somewhat similar pattern supporting twenty-five lights each, while pendent from the arched ceiling is an electrolier with about 75 lights. In the various rooms are massive bronze wall brackets and graceful electroliers, while hundreds of portable lights are placed near or upon the tables and newspaper racks. Every separate design in fixtures is in strict accord with the general surroundings in each hall, corridor, room and alcove, and reflects great credit on the Archer-Pancoast Co., of New York, who supplied all of them.



SIEMENS & HALSKE DYNAMO PLANT, BOSTON NEW PUBLIC LIBRARY.

VI.—STEAM PLANT.

The steam plant consists of two tandem compound engines of 150 H. P. each. The engines are of the non-condensing type and were adopted for the reason that the exhaust steam will be required in cold weather for heating the building throughout. They are run at 125 revolutions per minute. The entire plant was installed with the idea of running it constantly and using storage batteries, but as yet the latter have not been installed. The engines were designed by Mr. E. D. Leavitt, Jr., of Cambridgeport, Mass., who has designed many engines of a similar type for the city of Boston and other municipalities, and were built by the I. P. Morris Engine Co., of Philadelphia.

The valve attachment of these engines is the well-known Leavitt type, and is known as the cam valve gear. This type has been adopted on many pumping and mining engines throughout the country, and gives excellent satisfaction. The fly wheels are cast in two pieces and are 12 feet diameter over all, and very heavy. Over the cylinders are installed water heaters which are expected to assist greatly in the economizing of fuel.

VII.—BOILERS.

The steam generating plant consists of a bank of three horizontal tubular boilers made of open hearth fire-box steel, having a tensile strength of 55,000 pounds per square inch. Each boiler is 17 feet 4 inches long and 60″ in diameter, provided with 92 lap welded tubes 3″ diameter and 16 feet long. Each of them is provided with a Baily patent fusible plug in case of emergency. There are two sets of furnace doors in the cast iron overhanging front, the Bannister rocking-grate being used in the furnaces. These boilers were made by E. Hodge & Co., East Boston. The boiler and auxiliary plants were designed by Mr. Fred. Tudor, consulting engineer, being supplied and installed by the Walworth Supply and Construction Co., of Boston. They consist in addition to the boilers of two No. 4 Davidson feed pumps; one Berryman feed water heater of 200 H. P. made by I. B. Davis & Son, of Hartford, Conn.; one Hancock inspirator; one special air pump of Davidson type for operating the pneumatic tube system.

Taken all in all the equipment is a notable one. Nothing has been spared to make it as efficient as possible, and the proportion which the entire cost of the heating, lighting and ventilation plants bears to the gross expenditure of nearly $3,000,000 on the entire library building is proving to have been profitably invested. The architects of this colossal and magnificent institution were the well-known firm of McKim, Meade and White, of New York City.

ELECTRO-MECHANICAL ANALOGIES OF SUBMARINE CABLING.

THE comprehension of electric phenomena is greatly facilitated when a correct mechanical analogy can be found. In his recent lectures at the Royal Institution, Professor George Forbes showed a mechanical model of the current sent through a submarine cable, and this model was on view at the recent Royal Society Soirée. In a long glass tube some 3 in. in diameter a thread suspended vertically in oil represented the cable. It was hung from a spring which represented the sending condenser, and at its upper end it had a vaned wheel, against which jets of air could be driven to twist the thread to right or left. The torsion represented electromotive force resulting from positive or negative impulses from a battery. At the bottom end of the thread was a mirror with a magnet behind it, controlled by an external magnet, the analogue of the receiving condenser. The fluid friction represented the electric resistance, and the twist the charge. On the same stand was an artificial electric cable equal to 2000 miles long, and the two were worked from the same keys. Each sent a spot of light on to a screen, and these two spots were seen to move similarly, if not identically, when messages were sent. This model is likely to become popular with teachers of electrical science, and is a beautiful example of how one form of action may be explained by aid of another.

ELECTRIC FOUNTAIN FOR THE ATLANTA EXPOSITION.

President Collier, of the Atlanta Exposition, has closed a contract with H. R. Worthington & Co., of New York, for the pumps to supply the electric fountain at the Cotton States and International Exposition. The capacity of the pumps is 40,000,000 gallons in twenty-four hours, or double the capacity of the Atlanta water-works pumps. Worthington & Co. will make, in connection with this, an exhibit covering 8,000 square feet. The electric fountain is designed by Mr. Luther Stieringer, who is consulting electrical engineer for this Exposition, as he was for the World's Fair.

ELECTRIC POWER TRANSMISSION PLANT DRIVEN BY GAS ENGINES AT AUBERVILLIERS, FRANCE.

INCREASE in the business of M. Paul Linet, manufacturer of chemical products at Aubervilliers, France, determined that gentleman to entirely remodel his power plants, and the results obtained with the new arrangement which has now been in operation for several months are of considerable interest as demonstrating the low cost at which the gas engine can be employed when the gas is produced on the premises. The products manufactured by M. Linet created a large quantity of dust, which made it inadvisable to install a mechanical transmission plant, and to this was added the fact that the different points at which power was required were considerably scattered. An electric transmission plant was therefore determined upon with the generators driven by three Simplex gas engines built by Delamare-Deboutteville & Malandin, fed by a battery of gas generators of the Buire-Lencauchez type, built by Matter & Co. of Rouen. The electrical installation was carried out by the Gramme Company.

The three gas engines, one of which is illustrated in Fig. 1, are of 80 H. P. each, and each drives a generator

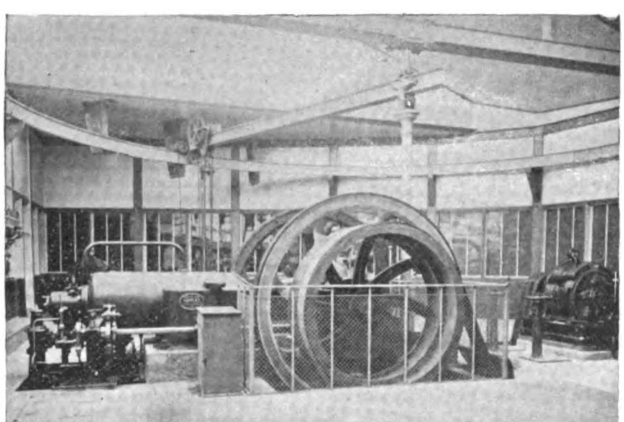


FIG. 1.—ELECTRIC TRANSMISSION PLANT, AUBERVILLIERS, FRANCE.

through a system of transmission placed below the level of the engine room floor line, and they are arranged to drive also the lighting dynamo and a pump. The gas generators are adapted to run either singly or together, the gas being carried to a gasometer after passing through the purifiers.

A very complicated problem was presented in the working out of this installation, as it was necessary to drive at will any one of the four dynamos and a pump by means of any one of the gas engines, and by means of a steam engine which had also been installed. This was effected by means of a main and counter-shaft, as shown in the engraving, Fig. 2, and a system of clutch pulleys and idle pulleys.

The three generators have a capacity of 56 K. W. each and about 20 motors are scattered over the works, varying from 4 to 15 K. W., together with a lighting dynamo of 26 K. W. capacity. A test of the plant was recently made,

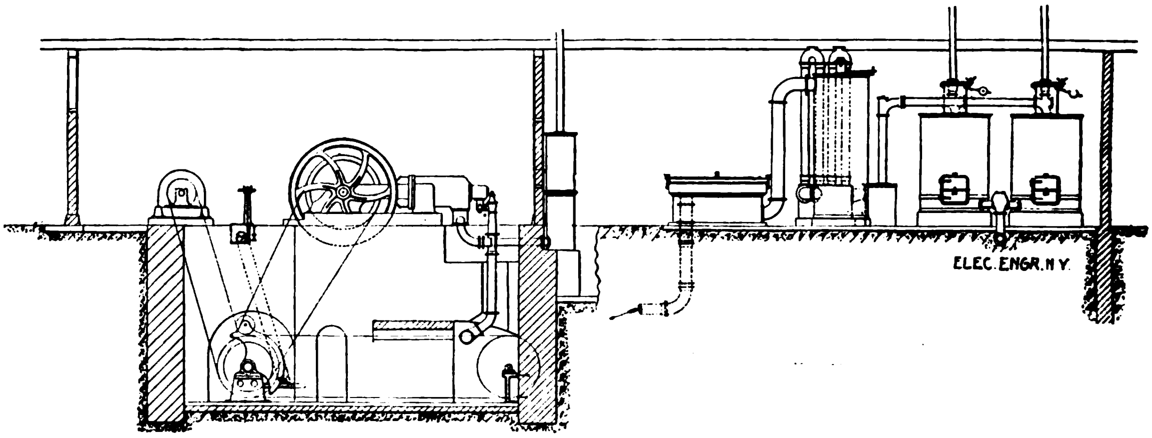


FIG. 2.—ELECTRIC TRANSMISSION PLANT DRIVEN BY GAS ENGINES FED WITH GENERATOR GAS.

indicator cards being taken from the gas engines, five or six curves being taken successively on the same card, with cards taken every quarter hour for four consecutive hours. The following are the results of the test :—

Diameter of cylinder	22.8 in.
Stroke	30.00 "
Total coal consumed, net	510 lbs.
Duration of test	4 h. 15 m.
Mean speed	120 R. P. M.
Mean power at the brake	80.25 H. P.
Indicated horse-power	103.5 "
Efficiency	76.9 %.
Maximum power at the brake not including missed explosions	94.5 H. P.
Indicated maximum power not including missed explosions	122.7 "
Indicated power of small gas engine, estimated	4. "
Indicated power of both engines	107.5 "
Coal consumed per hour	128 lbs.
Coal consumed per hors -power hour at brake	1.45 lbs.
Coal consumed per indicated horse-power hour	1.12 "
Coal consumed per indicated horse-power hour for the two engines	1.07 "

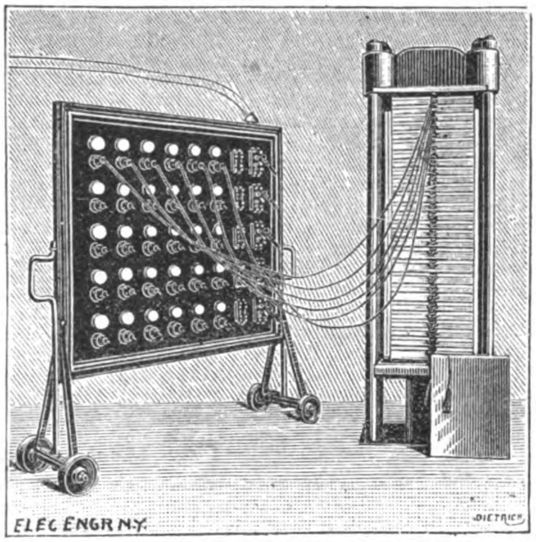
This shows a consumption of less than 1.5 lbs. of coal per brake horse-power hour and confirms the value of gas engines for electric current generation.

INCREASING THE WATER POWER OF MINNEAPOLIS.

The project of building a new dam across the Mississippi River at Minneapolis, which has been discussed for over a quarter of a century, is at last under way. The dam will be erected by the Pillsbury-Washburn English syndicate. Its object is to utilize the power which has for so many years been wasted and to increase by one-half the water power of the city of Minneapolis. The power will be used in generating electricity for general purposes. The dam will be two years in building. It and the power house will cost about $1,000,000, and for the expenditure of this sum the syndicate expects to realize about 10,000 horse power or 150 mill power. The dam will be 900 ft. long. The power house will be three stories high, 290 feet long and 100 feet wide. It will contain forty turbine wheels, arranged to be used in sets of four. In times of low water the flour mills of the city are now compelled to use steam, so that the profits of milling are largely decreased. The new dam gives more than enough cheap power for all the needs of the city.

CLAVIEZ'S METHOD OF FINISHING CLOTH AND PAPER BY ELECTRICITY.

FOR finishing certain kinds of woven fabrics and also to obtain the moiré and figured effects, use has heretofore been made of hydraulic presses and heated plates, between which the fabrics or the papers are placed, the plates being previously heated in furnaces. The difficulty with this system is that during the operation the plates cool and the action is not a regular one. To obtain entire regularity of action, Mr. Emil Claviez of Chemnitz, Germany, designed the electrical press shown in the accompanying illustration, taken from *La Nature*, in which the plates are heated electrically. The current from the generator is led to a



CLAVIEZ ELECTRIC CLOTH FINISHER.

switchboard and from there by flexible cables directly to each of the plates in the press. The plates are hollow and the heating wire is wound in the shape of a spiral, having sufficient resistance to produce the necessary heating effect. The arrangement is quite simple and possesses the great advantage that the temperature can be regulated to a nicety. The apparatus ought to find a large application among American manufacturers of woven fabrics and paper.

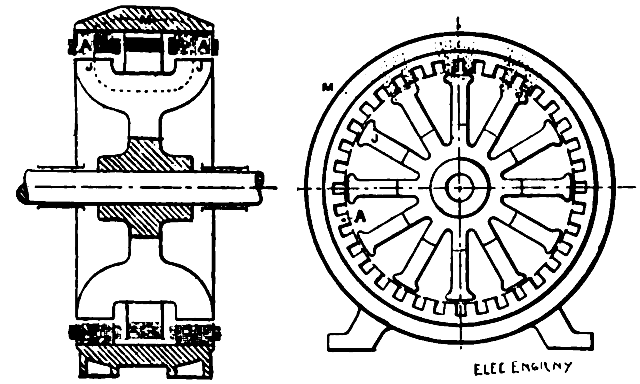
ROTARY-CURRENT AND ALTERNATING-CURRENT DYNAMOS OF THE ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT.[1]

BY M. VON DOLIVO-DOBROWOLSKY.

The relatively large number of poles in alternating-current machines which were necessary to reach a high number of alternations at a small number of revolutions, rendered an economical design of the field-magnets most difficult. A certain saving was, however, effected by using one field-winding to do the whole work, instead of exciting each pole separately. The first alternator of this kind was probably that of Klimenko of Charkow, which was exhibited at the Vienna Exhibition in 1883. The bad proportioning in the design of this machine prevented it from coming into a more general use. The Mordey alternator of the latter end of the eighties, which is really derived from the Klimenko machine, was, in fact, the first practically useful machine with a single-coil magnet. To-day there are many modifications of this type of machine in existence, as, for instance, the one built by the Maschinenfabrik Oerlikon with Brown's inductor, and several others. One might predict that the single-coil magnet arrangement will come to the front in the construction of alternators in the same way as the ring-pole arrangement with radial magnets has, in the case of continuous-current dynamos, displaced all previous forms of magnets. Besides its main advantage, economical excitation, the exciting coil of a single-coil magnet in some of its forms may be made stationary so that only the magnet core with its poles revolves. The 1883 machine of Klimenko was without any revolving wires. On the Mordey alternator the magnet coil could also be made stationary; the reason for not doing this in practice lies entirely in the mechanical difficulty of securing the relatively heavy coil to the light disc armature in a workmanlike way. After this introduction, I come to the description of two types of alternators built by the Allgemeine Elektricitäts Gesellschaft of Berlin.

1. Paper read before the Elektrotechnischer Verein, Berlin.

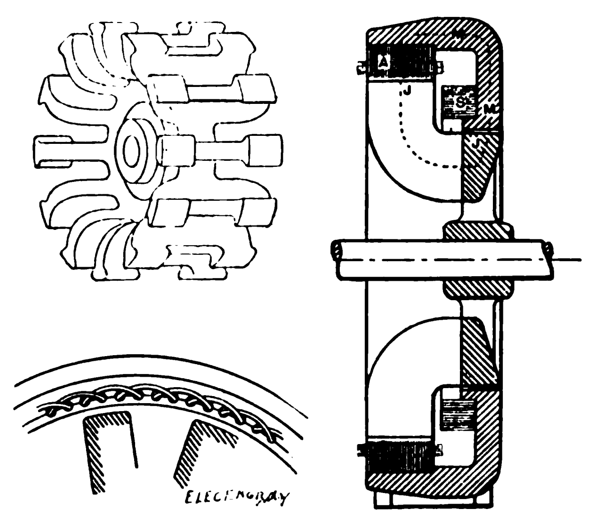
Both types belong to the single-coil magnet class with stationary winding. The first kind, shown in Figs. 1 and 2, is most suitable for high speeds, consequently for belt or rope driving. From both illustrations it will be seen that the magnetic circuit is completed by the outer case M, the two armature rings



FIGS. 1 AND 2.

A, which are built up of laminated iron, and the tooth-wheel or turbine-wheel inductor J, which latter is shown separately in Fig. 3; S is the exciting coil and is fixed to the frame M. The pole-pieces of the inductor-wheel give rise on the inner face of the armature rings to points of very uneven distribution of field, so that by rotating the inductor the armature coils, which are to be seen in Fig. 2, receive an induction through the number of lines of force which flow in them being changed. On the outer face of the armature A the distribution of field is homogeneous, and therefore nothing prevents the lines of force being led through the frame M. Here I will remark at once that similar machines have lately been built by Stanley in America, and also by Sollman, of Wahl & Co., in Russia. The Sollman alternator was described in the Russian *Elektrotechnische Zeitschrift* a short time ago. A number of alternators of this type have been designed, some also with the modifications as shown in Fig. 4. A 100 H. P. "drehstrom" generator of this type is now at work at the sugar refinery of Messrs. Schwengers Söhne, at Uerdingen, on the Rhine. Of course this kind of machine is suitable for either single-phase, multiphase, or "drehstrom" current. In Fig. 2 the number of armature coils is three times as large as the number of pole pieces, whereby three currents of 120 deg. phase difference are produced. Instead of the pole-like arrangement of the armature winding, the opposite coils can be connected, which is admissible for machines of low voltages, and sometimes even an advantage. In larger size machines the bar winding can be used, as shown in Fig. 5, where each of the coils consists of only one copper bar. Three machines of this type, of 300 H. P. each, are at present under construction at the works.

Besides this type of machine, which is, as stated before, more

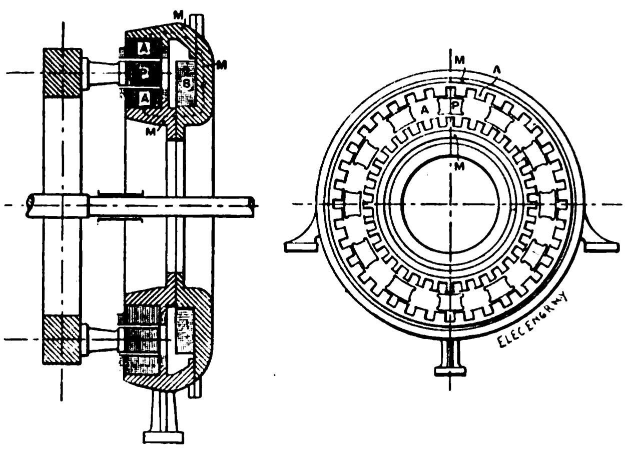


FIGS. 3, 4 AND 5.

to be recommended for the high speed, we are also building a slow-speed machine of a smaller width, but greater diameter, suitable for direct driving. The same is also on the Klimenko principle. Figs. 6 and 7 show clearly that the magnetic lines generated in the large exciter coil S run evenly through the iron ring M and the two armature rings A when the magnetic circuit is closed by

pole-pieces P. When these pole-pieces, which are fixed to the flywheel of the engine, rotate, points of high magnetic density evidently travel along the surface of the two armatures, and the armature coils, which are clearly shown in Fig. 6, receive an induction. Things can, of course, be also arranged for multiphase currents by simply using a proper number of coils relatively to the poles. Rotary current dynamos of this class are at present being built for the Electric Supply Station at Strassburg, viz., three of 400 H. P., and two of 200 H. P. each.

Besides the advantage of having no collecting brushes, the little attention which these machines require, the simple and strong construction, is at once evident even from the illustrations. It is impossible to touch the high-pressure coils when the machine is running, as the revolving flywheel in front of it prevents this. When repairing, the whole frame can be moved back, and the armature winding becomes easily accessible. As to the electrical advantages of this type of machine, two must be specially mentioned, first the economic excitation, secondly the very small drop of potential. Some consideration should also be given to the naturally small hysteresis, which, in combination with the little exciting current required, enables an especially high efficiency to be obtained, even at light loads. To demonstrate these advantages by data, I will give you the principal figures of the 400 H. P. machine for the Strassburg station:—Output, 280 kilowatts at 2,750 volts; revolutions, 150 per minute; number of poles, 40; weight of copper of magnet coil, 730 kilogrammes; weight of copper of both armatures, 200 kilogrammes; excitation required, 4,000 watts—about 1.4 per cent.; total watts consumed in both armatures = 2 per cent.; total hysteresis loss about 1.3 per cent. This machine requires, in spite of the small loss, only a little over 2 kilogrammes of copper per horse power. The ratio of the



FIGS. 6 AND 7.

effective ampere-turns of one armature coil to the ampere-turns of the exciter coil is about 1.15.

That the weight of iron is not in consequence very high the following figures will show :—

Frame	6,000 kg.
Both armatures	2 000 "
Pole-pieces	750 "
Total weight of iron exclusive of shaft and bearings..	8,750 "

Before I conclude, I would like to refer once more to the discussion of last meeting on the most suitable fall of potential in alternating current dynamos. As is known, Hopkinson in the eighties found by calculations that for the synchronous running of two alternators a certain ratio between resistance and self-induction was most suitable, and that the self-induction had the most important *rôle*. From this many concluded that plenty of self-induction must be provided, as it is nearly impossible to calculate the Hopkinson ratio in advance. But often the machines got too much of it, and the consequence was, they would get out of step. This was explained by saying there was still not enough induction, and we eventually tried to bring the machine to such a point that by means of self-induction it could not give more than 1½ times its normal output. Mordey, at the end of the eighties, maintained just the contrary, *i. e.*, that alternators should have little resistance and little self-induction. The smaller the fall of potential of the machine the easier large currents could be got out of it. However, the most practical and demonstrative proofs of Mordey could not at once shake the general belief in self-induction, and the dispute is still unsettled to-day. Of course, after the many experiments with alternators with a small fall of potential, which have been proved to run just as good in parallel as alternators with a large one, certain theorists have moderated their demand, and in fact are already satisfied with a fall of potential of from 15 to 20 per cent. I think one can predict that dynamo constructors will soon come to the general opinion that a little fall of potential more or less is of no consequence to good parallel running, especially as there are no practical proofs that too little resistance or self-induction has ever prevented alternators running in parallel satisfactorily. When, however, neither parallel running nor the conditions of synchronism require a large fall of potential, the most important argument for building alternators with self-induction disappears. The fall of potential has many disadvantages which are specially felt in motor driving. The wattless current component operates with its full ampere-turns in the direction of the magnetomotive force of the primary machine; therefore with motor currents one has a bigger reduction of the magnetic field than with lighting currents, and a machine of the latter class with a fall of potential of 15 per cent. is therefore not suitable for satisfactory motor work. If we consider that small motors seldom have cos φ more than 0·7, and large ones scarcely above 0·87, and, on the other hand, figure to ourselves that the wattless component amounts to from 0 7 to 0·5 of the whole current, we can easily perceive what a detrimental result the above mentioned subtraction of ampere-turns must have. As, however, at the present time the motor question requires the greatest consideration on the part of electric supply stations, doubtless the question of dynamo design will be answered in one way only, that is, to have the smallest possible fall of potential. No lowest limit can be fixed to this, as even the best of existing machines are far from being perfect in this direction. In my opinion, and according to my experience, it is entirely necessary and quite possible that the fall of potential due to the lighting current should not exceed 4 to 5 per cent., as even then we have still at full load with motor current a fall of from 15 to 20 per cent. The only intelligible reason which was brought forward against such machines is the danger of short-circuiting. Experience with continuous currents has taught us, however, that the dynamos are better protected by good fuses and automatic cut-outs than by a counter-compound winding. Therefore with alternating current—rotary current work—we can very well do without the self-induction, which otherwise only deteriorates the machine.

In conclusion, I should like to remark that in the last part of my Paper I have treated the self-induction and armature reaction to a certain extent as one, which is not quite correct. However, it was rather an explanation of the self-induction itself I wished to give you to-day than its origin and calculation. Besides, both phenomena are very nearly related and generally appear together, and are of the same order, so that machines with much reaction have likewise large self-induction, and *vice versa*.

POWER TRANSMISSION IN WASHINGTON TERRITORY.

An electric power house, next in size to the Niagara Falls plant, is to be built this year, in Stuck Valley, ten miles east of Tacoma, State of Washington. The White River Water Power Company, with a capital of $2,000,000, has been incorporated under the laws of New Jersey. Water power is to be secured by tapping the White River below Buckley, from which by an open ditch, it will be carried to Lake Tappa, near Sumner, utilized as a reservoir. From the end of the lake, the water is to be diverted by a flume to the bluff overhanging Stuck Valley, giving a fall of 400 to 500 feet to the power house, where will be located generator capacity of 25,000 horse power, not counting the surplus power stored in Lake Tappa, by use of which it is estimated that 50,000 horse power can be developed.

POWER CANAL TO BE BUILT AT LOCKPORT, N. Y., AND ALUMINUM WORKS ERECTED.

Lockport, N. Y., is rejoicing over the fact that its popular scheme of a big Power Canal is assuming definite shape, and that plans have been substantially matured for the consummation of that long desired and long talked of project. Its needed stimulation is said to have been effected by the Mannesmans, the great German capitalists and steel tube manufacturers, who have for some time held options on the proposed undertaking. The scheme involves a grand power waterway from the Niagara River to Lake Ontario via Lockport; and when completed it will be one of the most notable engineering achievements of the day. The Mannesmans are also reported to have bought the big Cowles Aluminum works north of the city, which have long been idle, and which will now be remodeled and used for the manufacture of steel tubing.

WORTH TEN DOLLARS.

"I find it more convenient to purchase your paper weekly at the news stands as I have done for several years. While it costs me $5.20 per year that way, I would not be without it did it cost $10 per year. Best wishes for the continued success of THE ELECTRICAL ENGINEER."

ELECTRIC TRANSPORTATION DEPARTMENT.

STREET RAILWAY CONSOLIDATION IN KANSAS CITY.

THE speedy consolidation of all the lines of street railway in Kansas City owned and controlled by the Metropolitan Street Railway Company, the Grand Avenue Cable Railway Company and the Kansas City Cable Railway Company is now an assured fact. This was definitely settled at a meeting of the directors of the Metropolitan Company when it was voted to increase the capital stock of the company from $3,600,000 to $8,500,000, and the consolidation agreement already entered into between the companies was ratified. The increase in capital stock of the Metropolitan Company is for the purpose of enabling that company to acquire the stock of the other companies concerned in the consolidation. The new organization will also take in the Kansas City & Independence Rapid Transit Railway, which is now being converted from a steam to an electric line; the West Side Electric and the Kansas City Traction Company's line in Kansas City, Kas. Under the plan of reorganization it is intended that the consolidation shall go into effect by the first of June. C. F. Morse, president of the Metropolitan Company, will be president of the consolidated companies, and Walton H. Holmes, president of the Grand avenue system, vice-president and general manager, with Conway F. Holmes as general superintendent, R. J. McCarty, of the Metropolitan system, retiring.

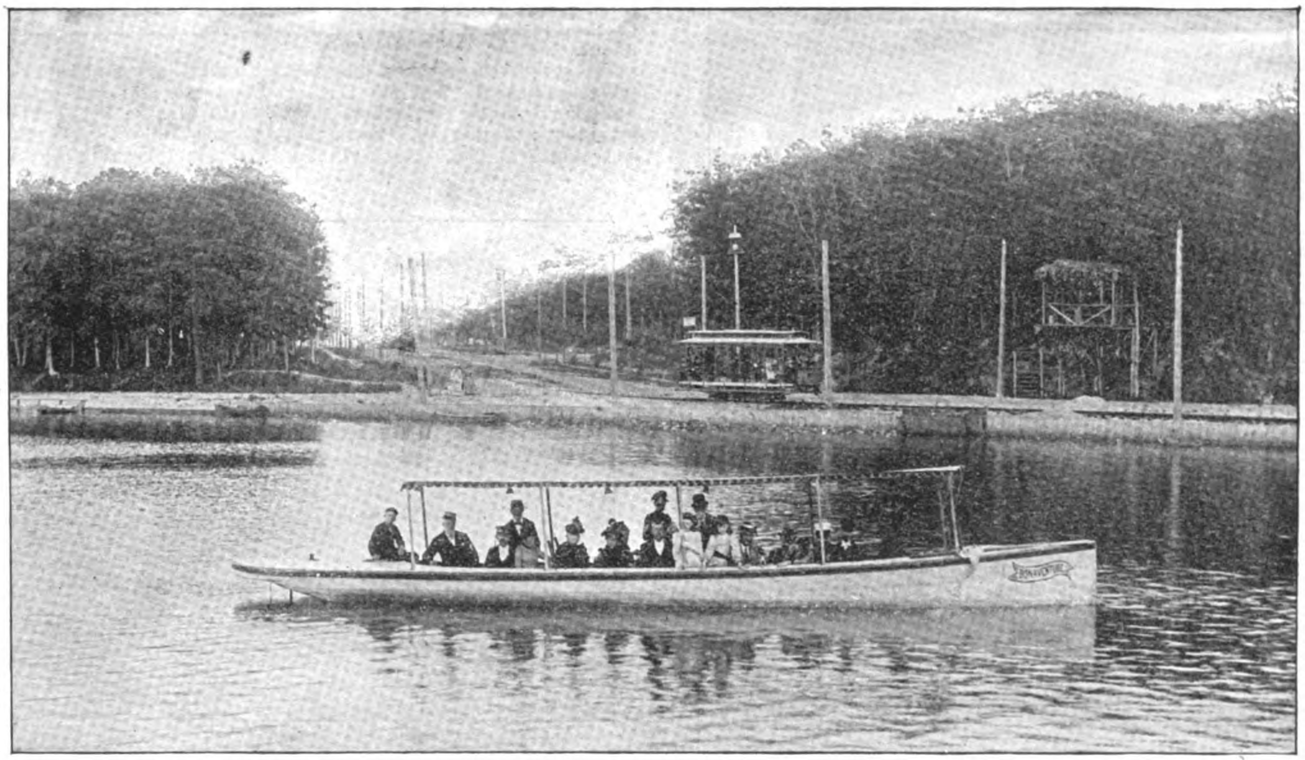
The consolidated companies will retain the name of the Metropolitan Street Railway Company, and will own and control altogether 12½ miles of street railway, more than half of which is run by cable, and a good portion of the remainder by electricity.

The plan of consolidation which was agreed upon several months ago is for the Metropolitan, with its increased capital stock, to acquire or absorb the other companies, thus uniting all into one big consolidated company. The value of all the Metropolitan companies was figured at $2,793,400. The bonded indebtedness of the Metropolitan Company is $3,600,000; that of the Grand avenue, Kansas City and Rapid Transit lines is $3,300,000, and $330,000 is to be expended in the outright purchase of all the properties of the West Side Electric and Kansas City Traction Companies. This amounts to a total of $7,230,000, and with the capital stock of the new company increased to $8,500,000 will leave a surplus of $1,470,000, which is to be held in the treasury as a reserve for improvements and extensions, a number of which are in contemplation.

THE HICKLEY ELECTRIC LAUNCHES.

It is perhaps somewhat surprising that since the successful demonstration on a large scale at the World's Fair, of the feasibility of electric launch work, there have been so few efforts made to develop this field; but the reasons are numerous and one that is all sufficient may be found in the financial conditions that have existed during the past two years. Conditions are now rapidly improving, however, and one of the signs of the times is the interest shown in electrical navigation. Probably more boats propelled by electricity will be set afloat this year in the United States than in any previous season, and their utilization will not be confined to any single section of the country. With familiarity will assuredly come popularity, and in due time electric boats will be as thick upon the water as bicycles are upon the land. There are so many elements in their favor, and there are so many changes imminent rendering them easier and cheaper to operate, that it is impossible their vogue should be much longer delayed.

Among those who have steadily entertained this faith is Mr. A. S. Hickley, a well known inventor and electrical engineer, who since taking charge of the electric railway system at Asbury



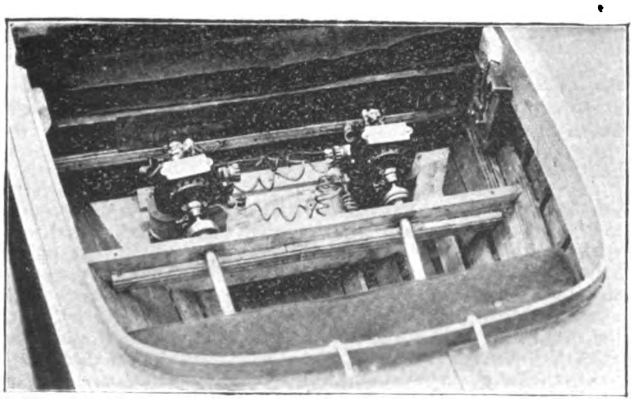
LARGE HICKLEY LAUNCH AT DEAL BEACH, N. J.

Park has availed himself of the excellent opportunities presented there to experiment freely and successfully with various types of boats. During the past year or two he has added to the pleasures of the famous summer seaside resort by putting launches on Deal Lake, a pretty little sheet of water barred off from the sea by sand banks and penetrating some distance inland between lawns and bits of shaded wood. As manager of the trolley line, he tapped the circuit at a convenient point and brought the current to the batteries through an amusingly simple resistance comprising an iron pipe more or less completely plunged into the moist sand of the lake beach. This plan has been varied, but only so far as to use a barrel of water in which the incoming and outgoing plate terminals are varyingly immersed. Two boats have constituted the "fleet." One of these, the "Bonaventure," 36 feet long 7 feet beam, draws 18 inches of water, and will carry 36 people at the rate of 8 miles an hour, using 110 cells of battery. The other boat is the "Dart," 32 feet long, 7½ feet beam, and 2¼ feet draught, furnished with 55 cells. The boats though making no pretensions to magnificence have done good service, carrying hundreds of people from week to week. One of them is here shown in Fig. 1. They have been managed without any great effort by Mr. Hickley and a young

son. Mr. Hickley had satisfied himself, however, from the numerous inquiries received, and from his own experience that smaller boats than these would meet a wide range of wants and prove popular; and he was, moreover, of opinion that great improvement was possible in the batteries and in the equipment generally. As the result of further invention and experiment, he is this year building a fleet of boats of a

THE HICKLEY DOUBLE SCREW ELECTRIC LAUNCH.

very interesting type, for which a large demand may fairly be expected. This type of boat, of which the writer has made trial for himself, is illustrated on this page. The boat here shown is 16 feet 6 inches long and carries six persons on cross benches, with the navigator in the stern. With one 6 inch propeller and a motor of his own winding, weighing less than 50 pounds, and with 8 cells of battery, the boat makes 4 miles an hour. With 16 cells, the boat makes 6 miles an hour the propeller running at 1250 revolutions per minute. Mr. Hickley has not been altogether satisfied in bygone seasons with the batteries



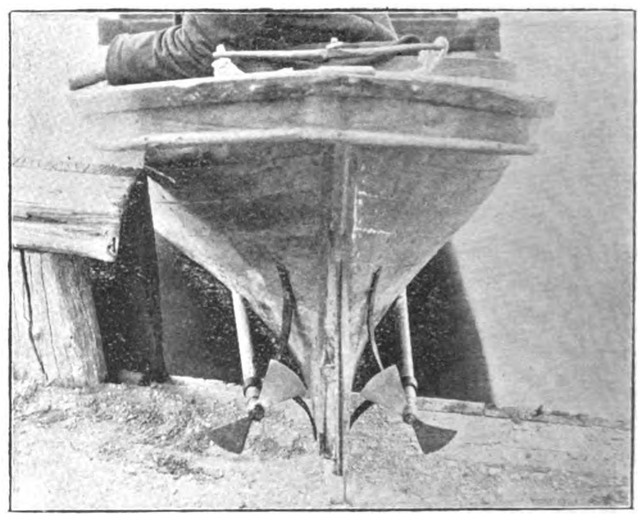
MOTORS ON HICKLEY DOUBLE SCREW LAUNCH.

then on the market and has latterly been using Planté cells of his own construction, with plates composed of filaments of lead wire. These give a very large surface, and have answered admirably.

Mr. Hickley has also taken this same type of boat and equipped it with twin propellers, each driven by a small ¼ H. P. motor of Crocker-Wheeler type, specially rewound. Our illustrations above show the Hickley patented method of employing a tube through which the propeller shaft runs. The end of the tube inside the boat next the motor is above the water line. The use of a stuffing box is thus avoided, and the journals being very free offer practically no mechanical resistance. The shaft is really lubricated by the water in the tube surrounding it. The economy of using two motors seems high for the reason that more combinations of motors and batteries are possible at a greater number of points of high efficiency. There is also the advantage that one always has a spare motor should either break down. Both are manipulated by means of the simple switch shown in the engraving. When the lever is thrown forward, the launch goes ahead; when it is thrown back, the launch reverses,—when the lever stands upright the battery is cut off and the boat stops; so that there is no resistance or wasteful commutation.

It is impossible to see this handy little boat and not feel that a great future awaits such craft. Certainly price cannot stand in the way if current is obtainable. Such a launch, well finished, smooth build, copper rivetted, highly varnished, with batteries either secondary or primary, a motor, switch and propeller, all ready to run, is furnished F. O. B. at Asbury Park for $350. The same 16 foot boat, clinker built, of painted cedar, can be had for $250. The writer has no hesitation in mentioning these figures, because he believes he does a public service in quoting them. There is a lingering superstition that electric launches are beyond the public reach, and it cannot be too vigorously combated. It is believed that with boats of this size, many street railway companies, hotels on inland waters, etc., can hire them out at a good price during the summer months in the north and the winter months in the south. The number of those who are fond of the water and of water sport, but wish neither to row nor to handle sails, is very large; moreover, electricity at once renders women or invalids quite independent of physical exertion in cruising about.

To supply these boats, together with auxiliary and other electric supplies, the Hickley Electric Launch & Manufacturing Co. has been organized at Asbury Park, with Mr. A. S. Hickley as president; Claude V. Guerin as secretary and Wistar H. Stokes as treasurer. The Company has started a factory and begun the



HICKLEY DOUBLE SCREW ELECTRIC LAUNCH.

season by securing the contract for seven fine electric launches, of 30 feet each, to be placed on the ornamental waters at the Atlanta Cotton State Exposition this Fall. As no electric boats have yet been seen in the South, or so far inland, it is believed that the novelty of this fleet will do much to aid the cause of electrical navigation.

A BROOKLYN TROLLEY COMPANY OFFERS $300,000 CASH FOR A FRANCHISE.

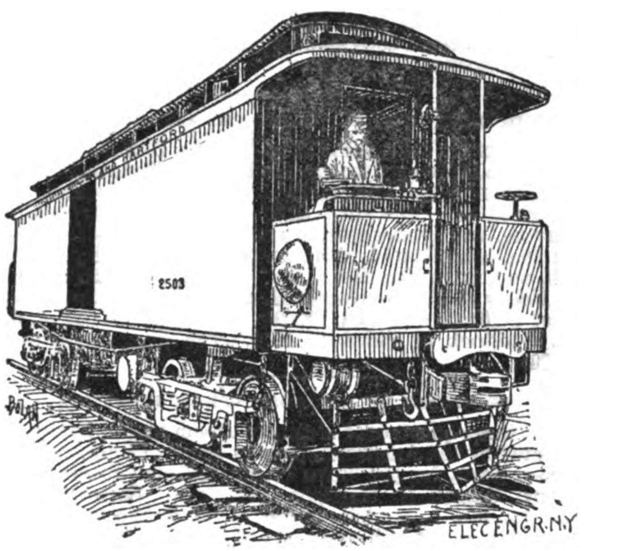
It is said that the present Brooklyn Board of Aldermen have not passed a dull moment in the discharge of their official duties since they took in hand the extensive contract of reforming the affairs of the city. An event of unusual interest is now announced which will probably bring into renewed prominence the autocratic characteristics of the famous "Cold Thirteen." The annulment by Justice Smith of the Supreme Court, of the franchises granted by the "Cold Thirteen" to the Nassau Electric Railroad threatens to reopen the railroad battle that raged so fiercely in the time of Mayor Boody, and which played such an important part in the overthrow of the Democratic rule in Brooklyn. The Union Street Railway Company, which was the chief opponent of the Flynn syndicate before the 1893 Board of Aldermen, and

which has since been fighting it in the courts, has submitted a petition renewing its requests, made in May and June, 1893, for permission to construct and operate an electric railroad from Ferry place through Hamilton avenue to Union street, and through Union street to Ninth avenue.

For the franchise the company offers 3 per cent. of the annual earnings, gross, and $300,000 in cash. The lump sum is to be deposited to the joint credit of the city and the company until the company shall have obtained the necessary consents of property owners, and the sum will then be turned over to the city. The officers of the company are: Reuben Leland, president; John Greenough, vice-president; Edward M. Grout, secretary, and Edward Wilder, treasurer.

THE NANTASKET BEACH MOTOR CARS.

Supplementing our previous and copious data on the subject of the conversion of the Nantasket Beach division of the N. Y., N. H. & H. R. R. from steam to electricity, we are now able to present a picture of one of the motor cars intended for this work.



NANTASKET BEACH COMBINATION MOTOR AND BAGGAGE CAR.

Four baggage cars and six open cars will be equipped with motors for the hauling of trains on this branch. Two of the baggage cars will be equipped with two motors each and two with four motors. The open cars will have two motors apiece. All the motor cars are 200 horse power, the expectation being that the baggage cars equipped with four will haul six or eight loaded cars, or "trailers." The cars equipped with two motors will draw four cars, or a less number.

The four baggage cars are at present in the car shops of the New York, New Haven & Hartford road at South Boston, in process of equipment. The body of the car is 34 feet, the distance from the front to the buffer being 42 feet. When equipped they will weigh about 60,000 pounds. The motor cars will be furnished with air brakes, electric chime whistle and gong.

The open motor cars will have seats for passengers on the same general plan as the open cars of the street railway systems.

FENDERS IN MASSACHUSETTS.

The Massachusetts Legislature has enacted a law requiring all street railroad companies to equip their cars with fenders approved by the State Railroad Commission and fixing the penalty at $50 fine for each day's delay.

CONSOLIDATION OF PITTSBURGH ROADS.

A conference between C. L. Magee, of Pittsburg; Colonel Elkins and P. A. B. Widner has resulted in a perfection of all the arrangements for the consolidation of Pittsburg's four traction lines, the Pittsburg Traction Company, practically owned and operated by the Philadelphia Traction Company; the Duquesne Traction Company, comprising all of Mr. Magee's street railroad interests, immense franchise holdings and influence; the Citizens' Traction Company, and the Central Traction Company. Incidentally, the plans have been perfected with an eye to bringing the Allegheny lines within the new company. All of these lines originate in Pittsburg, crossing the various bridges of the Allegheny, as the South Pittsburg lines cross the Monongahela, and all centre in and about the centre of Pittsburg.

NATIONAL CONDUIT WORK IN PHILADELPHIA.

A LARGE number of the railway feeders of the Philadelphia Traction Co., of Philadelphia, are now being put underground, and the system adopted is that of the National Conduit Manufacturing Co. These conduits consist of iron pipes lined with cement and carried from manhole to manhole in groups, as shown in the accompanying engraving Fig. 1 which gives a view on Market St., Philadelphia, facing the Municipal Building. Fig. 2 shows a manhole into which the conduits are led and from which connections are made to the trolley wires. The National Conduit Mfg. Co. have laid and contracted for no less than 5½ million feet of their system in Philadelphia.

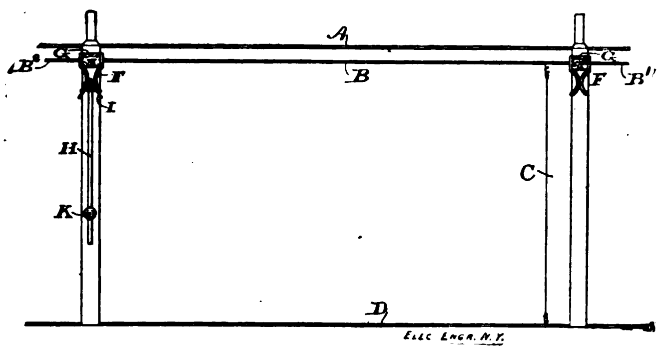
FIG. 1.—NATIONAL CONDUIT, MARKET STREET, PHILADELPHIA.

FIG. 2.—NATIONAL CONDUIT FOR RAILWAY FEEDERS, PHILADELPHIA.

HENRY'S METHOD OF LOCATING FAULTS IN ELECTRIC RAILWAYS.

In electric railways as ordinarily constructed, a fault in the track must be searched for between the points at which the feeders enter the circuit, and the only methods heretofore existing have been by the use of special testing instruments, or by exploration involving, in the case of electric railways in cities, more or less disturbance of the street surface, and consequent interruption of travel. These methods are objectionable on this account and further objectionable inasmuch as it is practically impossible to know the state of the entire track at any time by reason of the length of time necessary for effecting the various tests. It is to supersede these methods and to provide a means so convenient that the entire track may be readily tested every day, if desired, that Mr. J. C. Henry has devised the method illustrated in the accompanying diagram, and which consists briefly in providing a supplemental return conductor B B¹ B² divided into sections connected by spring switches F, each of the sections connected to the track and so arranged that an ammeter may be inserted between them or between the supplemental conductor and its connection with the track, to measure the current.

As ordinarily arranged, the main current returns by the track and the ordinary buried return conductor is connected thereto for the purpose of lowering the resistance. The supplemental conductor B is of comparatively high resistance. It however serves ordinarily to convey only a small percentage of the current back to the power house. Upon the occurrence of a fault in the track return, however, the current, instead of passing over the defective spot, will seek another path through the high resistance conductor, B B¹ B², the resistance of which for so short a distance would necessarily be much less than that of any serious fault in the track return; while beyond the fault the current would again flow mainly in the track circuit, the supplemental conductor thus forming a shunt around the fault, while not interfering with the



LOCATING FAULTS IN ELECTRIC RAILWAYS.

ordinary function of the track and its buried return as a conductor. The section of the supplemental conductor serving as a shunt will carry a very much greater current around the fault than the other sections of the supplemental conductor wherein the resistance acts to cut down the current and confine it to the track. Thus ammeters inserted between the sections or in the branch conductor will show a greater current passing in one section than in another and will locate the fault, which may be speedily repaired.

To enable readings to be taken more rapidly than ordinarily the ammeter is mounted upon a pole with its terminals upon the end of the pole connected by wires to the ammeter, and thus the operator may walk along from one pole of the road to another, and by inserting the ammeter terminals between the parts of the spring jack or switch, may take the readings rapidly and accurately, while at the same time the spring jacks or switches will be located so far above ground that they will be out of the reach of curious or mischievous interference.

ELECTRIC RAILWAY PLANS AT NILES, OHIO.

The Mahoning Valley Electric Railway Co., was organized in November, 1894, with a capital stock of $150,000, to run from Niles to Youngstown, O. It expects to be in operation by the first of August. Its officers are: C. F. Clapp, president; R. G. Sykes, vice-president; J. E. McVey, secretary, and A. A. Anderson, treasurer and general manager. It will adopt the overhead trolley. It has not yet made any contracts for system to be used. It will cover 10 miles of track, about one-half 66 lb. Johnson "0" trolley wire, running double trolley, but has not yet girder, and one-half 67 lb. Johnson "T." It will use No. purchased. No guard wires will be used. It will probably operate six regular motor cars with four extras. The order for cars and trucks has not yet been placed, and the boilers and engines are not yet contracted for. The power house will be of brick, with iron stack.

STREET RAILWAY BIDS WANTED AT NIAGARA FALLS, CANADA.

The Niagara Street Railway Company, of Niagara Falls, Canada, are contemplating changing their present horse road to the trolley system. The road is about five miles long, single track, and runs from Clifton to Suspension Bridge. They will obtain their power from the Niagara Falls Power Co., on the American side. They are in the market for four closed cars, trucks and car equipments, track and line material, and will probably let the contract complete. Address J. N. Hayward, 56 Broadway, New York, or C. J. Goldmark, 49 Liberty St., consulting engineer.

CONSOLIDATING ROADS AT NEWARK, N. J.

Negotiations are about completed which will make the electric systems of Newark practically one. There are now two, the Consolidated and the South Orange. The latter is owned by the Radels. They now have the right to run their cars over the tracks of the Consolidated Company from a point above the Court House to a point below the Market Street Station. They have held this right over three years, and it expires on the first of the new year. It is now proposed that the agreement be renewed, and that in return the South Orange Company allow the Consolidated to run its New York cars over the South Orange tracks through Ferry Street, thus shortening the time and clearing the street of an extra set of tracks.

CONSOLIDATING ELECTRIC ROADS AROUND NIAGARA.

An agreement for consolidation of the Buffalo and Niagara Falls Electric Railway with the Buffalo and Tonawanda Electric Railway, forming the Buffalo and Niagara Electric Railway, has been arrived at. The route of these two railroads forms a continuous line, but neither road has been yet completed. The directors of the consolidated company are W. Caryl Ely, Charles B. Gaskell, and Burt Van Horn, Jr., of Niagara Falls; Robert L. Fryer, Henry H. Pierce, George H. Dunbar, and John J. McWilliams, of Buffalo; Frank A. Dudley, of Niagara Falls, and Willard P. Whitlock, of Elizabeth, N. J. The consolidated capital is $1,250,000.

PROGRESS OF EXHAUST STEAM HEATING.

About three-quarters of a mile of steam mains has just been constructed by the American District Steam Company, of Lockport, New York, for the Terre Haute Indiana Electric Railway Company, Russell B. Harrison, president. Between now and October 1st, it is in contemplation to build two more miles of steam mains, which will make one of the most complete exhaust heating systems in the country. The Railway Company is also doing the city lighting under a five years' contract, and altogether has boiler capacity of twelve hundred H. P.

The Danville, Illinois, Electric Railway Company is also putting down steam mains this season of considerable extent; so as to utilize its exhaust steam for heating business houses and residences.

A LONG ELECTRIC ROAD FOR WISCONSIN.

The proposed electric railway from La Crosse to Black River Falls seems to be a go, and La Crosse has been selected as the headquarters back of the movement. The directors of the corporation, the La Crosse, Black River Falls and Neillsville Electric Railway company, have elected the following officers: President, Nathan Clark; vice-president, William H. Polleys; secretary, Paul McHugh; treasurer, T. J. McHugh; auditor, William Beirne; superintendents of right of way, T. J. McHugh and W. H. Polleys.

The first survey will be constructed by Onalaska, Miday, Holman, Mendora, Burr Oak, Oxbon and Melrose. Then a line will be run back from Melrose by way of North Bend, and Council Bay. The surveying party will then continue their work from Melrose to Black River Falls and Neillsville. The company's office will be located at La Crosse.

THE DUPLEX CAR CO. has organized at Concord, N. H., with H. A. Tuttle, of Pittsfield, as president; and A. H. Roby, of Boston, as treasurer. The capital is $100,000. The company's object is chiefly to make and sell a form of duplex car the construction of which is such as to allow it to be used for winter and summer travel alike, it being readily convertible.

H. M. LITTELL IN BROOKLYN.—It has been decided that H. M. Littell will succeed Benjamin Norton as President of the Atlantic Avenue Railroad Company in Brooklyn. Mr. Norton's resignation goes into effect on July 1. Mr. Littell has been the general manager of the New Orleans Traction Company, and it was under his direct supervision that 120 miles of trolley lines have been established. The system will be in operation when Mr. Littell gets to Brooklyn. Mr. Littell is also the President of the New Orleans and Lake Railroad Company. It is said that he will receive a salary of $15,000 a year as President of the Atlantic Avenue Company.

EDUCATIONAL.

THE ANNUAL CATALOGUE OF PURDUE UNIVERSITY, LA FAYETTE, IND.

Purdue University has published its annual catalogue for 1894–5. The University was established in 1869. It is the Indiana Institute of Technology and its purpose is to afford the young men and women of Indiana an opportunity to acquire a good collegiate education in mathematics, science, literature and art, and at the same time to secure instruction and practice in such lines of work as will fit them to engage in the practical industries. The instruction is both theoretical and practical. The course in electrical engineering is very thorough and admirably planned. The department is well supplied with dynamo machines, electric motors, and testing instruments for the most advanced investigation of the various problems of electro-technics. Particular attention is given to the designing of electrical machinery and appliances. The inspection of electrical installations of various kinds is part of Senior year work.

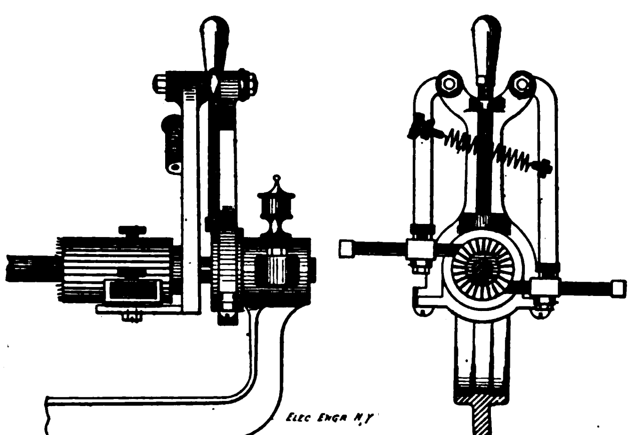
MISCELLANEOUS.

PROF. ELIHU THOMSON'S BRUSH HOLDER.

In the brush holders in common use the spindles upon which they are mounted are as a rule placed diametrically opposite each other in a plane passing through the centre of the shaft. It follows as a matter of course, with this construction, that while the brush when first applied may be placed in the most advantageous manner, its position, relative to the commutator, constantly changes as wear goes on with consequent destruction and irregular action on both brush and commutator.

In order to maintain a uniform position for the brush throughout its life, and to equalize the pressure against the commutator, Prof. Elihu Thomson has designed the arrangement shown in the accompanying engravings.

As will be seen, the brushes are given an end bearing on the



THOMSON BRUSH HOLDER.

commutator, and are applied in such positions that the range of movement permitted them lies, not in a plane cutting through the centre of the shaft, but in parallel planes intersecting the commutator above and below, respectively, a similar parallel plane drawn through the axis. The brushes are carried in clamps mounted on swinging supports in such manner that as the brushes, or the commutator cylinder, wear down so that the brush clamps stand nearer or farther away from the centre of the shaft, the same good contact will be effected.

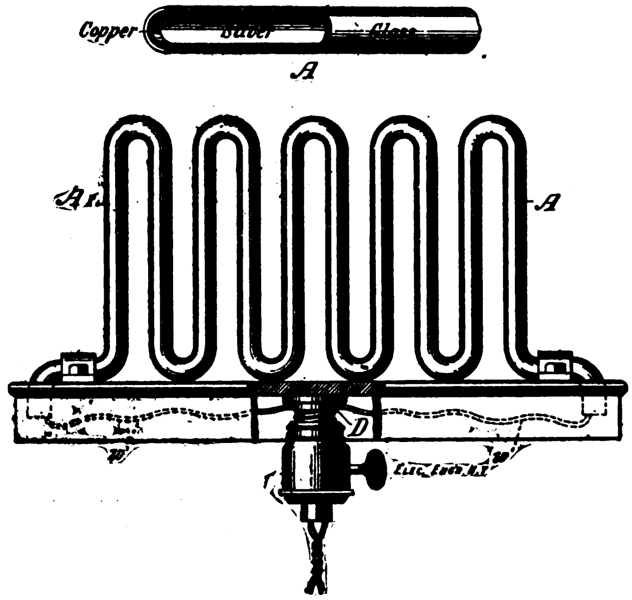
An important feature of the device consists in a special arrangement for maintaining an exact parallelism of the brush and brush clamp to the surface of the cylinder at all times. This consists of parallel links connecting the brush clamp with its support so that the brushes will always stand parallel to a given plane.

ELECTRIC POWER AT TOPEKA, KAN.

The city council has adopted an ordinance which contracts with a company for the immediate construction of a dam across the Kansas river. The city is to use 600 horse power at a yearly rental of $24,000. The company gives $20,000 bond to commence the work by the 4th of June and push it to early completion. David Fitzgerald, manager of the company, says the dam will be completed within eighteen months. It is the present plan to build the structure some distance above the city and transmit power in the form of electricity.

REED'S ELECTRIC HEATER.

In a patent just issued to Mr. C. J. Reed, of Philadelphia, that inventor describes an ingenious arrangement of an electric heater designed particularly to combine high resistance with high heat-radiating qualities. The heater, which is shown in Fig. 1, con-



FIGS. 1 AND 2.—REED'S ELECTRIC HEATER.

sists simply of a glass or porcelain tube upon the interior of which is a thin film of silver, deposited in the same manner as in the silvering of mirrors. In order to obtain a good connection for the wires leading to the switch the ends of the tubes are copper-plated, as shown at A, Fig. 2.

AN INCANDESCENT LAMP AS DYNAMITE.

An explosion, which the passengers in a Philadelphia trolley car believed to have been caused by an infernal machine or dynamite, was traced to an amusing source. An incandescent lamp in the coat pocket of the engineer of the British steamship "L'Oriflamme" was so suddenly crushed by a woman who sat down hard next to the engineer that its collapse caused a loud "pop." The car was vacated in a panic. The British engineer was roughly searched by the conductor in quest of explosives, and says he will file a claim with Uncle Sam for damages.

BIDS FOR LIGHTING THE MILWAUKEE CITY HALL.

The second lot of bids received by the board of public works for the lighting and heating plant of the Milwaukee City Hall are lower than the first because only three engines are called for now instead of four, as at first, and more freedom is given to bidders in regard to the kind of engines which shall be furnished. The Western Electric Company put in a number of different bids for different kinds of engines. The prices were as low as $25,406 and as high as $33,150. The General Electric Company put in bids from $29,980 to $34,231. The Westinghouse Company of Pittsburg placed its figures at $26,315. E. G. Bruckman of St. Louis puts in bids from $29,980 up to $34,231. D. Elmer Roberts of Racine bid $42,801.

There were thirteen bidders on the electric light and gas fixtures, as follows: H. W. Theis, $10,048; W. C. Vosburgh Manufacturing Company, Chicago, $12,128; C. E. Bigsby, $9,549; Arthur Polacheck, $9,586; Cassidy & Son Manufacturing Company, New York, $6,362; W. E. Goodman, $9,000 to $7,859; Grassler & Gezelschap, $8,284; E. T. Doyn, $9,968; Wisconsin Electrical Construction Company, $8,857; Halsey Bros., $10,700.32; Frank R. Dengel, $12,867; Archer & Pancoast, New York, $8,851.

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CONTENTS.

LAMPS: TWO FOR A QUARTER.

If a year ago, or even less, a dealer had hung out a sign or issued a trade circular of the above import, he would probably have suffered from lack of trade due to the doubts as to the genuineness of the offer, or as to the character of the lamp sold at such a price. Yet to such a point has the competition in the lamp trade been carried within the last few weeks that lamps have been sold at almost, if not quite, the price above quoted. In view of this state of affairs and of the important place which the lamp occupies in the art of incandescent lighting, it seems pertinent to consider whether in the first place such prices are justified or indeed demanded by the status of the art as viewed from the strictly commercial standpoint; or, on the other hand, whether, at such prices, any profit can possibly result to the manufacturer. From the very beginning of incandescent lighting as a commercial enterprise, there has been a steady and enormous increase in the lamps connected to the circuits; and whatever may have retarded the progress of the art, we are safe in holding that it was not the cost of the lamps per se. It would be futile to deny the beneficent effect more especially in the case of the isolated plants, of the gradual reduction in the price of lamps from $1 in the early eighties, to the more recent rate of twenty-five cents, but the advantages of the incandescent lamp over any other form of illuminant were at once recognized to be so great that the cost of lamps has always been more or less a secondary consideration. Besides, looked at from the standpoint of the central station, we believe that, in the past, the well managed stations have all paid dividends even with the price of lamps as high as 50 and 60 cents, so that no great reduction of lamp cost, comparable with that recently announced, appears to be called for. Besides, the growing practice of compelling consumers to pay for the lamps formerly furnished free by the central stations still further relieves the central station of a charge to which it was hitherto subject. Viewed from this standpoint, therefore, we can see no good reason for so radical a reduction in price as has just taken place. But are not the conditions now existing largely artificial, and can they continue without serious detriment to the manufacturers; or to put it plainly, can a good incandescent lamp be made and sold for 12½ cents and leave a profit to the manufacturer at the present time, without taking into consideration the steady rise in price of both material and labor, which has already begun to make itself felt in the glass industry among others? What does it cost to make an incandescent lamp?

We published an article recently giving in detail the cost of manufacture of incandescent lamps in Germany, which figured up, including all expenses for material, wages, operating expenses, loss by breakage, etc., at 11¼ cts. as the cost per lamp. The items given in that estimate were prepared from actual experience in the manufacture of lamps, and bear all the marks of genuineness. The lamps were not of the highest grade. We do not believe that anyone will seriously contend that labor and material are cheaper in America than abroad, and hence if we are to produce lamps cheaper than our foreign friends we can only do it by employing machinery in the place of hand labor.

But admitting even the advantage to be gained by the employment of machinery, we doubt whether the cost of an incandescent lamp can be much reduced just now below that given from the following estimate, also based on actual experience :

Glass	3.5	cts.	
Platinum	1.25	"	
Base	1.5	"	(average)
Filament, copper wire, etc	0.8	"	
	7.05		
Labor	5.	"	

Total, 12.05 cents.

This does not include the various other small additional expenses connected with the marketing of the incandescent lamp, such as labels, wrapping paper, excelsior packing, etc., nor does it include the considerable items of rent, insurance, general office and selling expenses. Taking all this into consideration it must be evident that, admitting even a considerable error in the estimate we have just given, there can be very little, if any, margin of profit in a cheap lamp sold and delivered at 12½ cts. Besides, it seems hardly likely that lamps sold at such prices can be run through the factory and selected with such care as to uniformity of voltage as to satisfy the consumer, for, after all, lamp users are gradually becoming educated to the fact that it is by no means the cheapest lamp that proves the most economical in the long run. Indeed, we are convinced that consumers are willing to pay, and cheerfully at that, from 20 to 25 cts. for a lamp which will show a fair economy and life. There is indeed small satisfaction in selling goods at a loss in times when a legitimate demand exists for a good article, and we can only deplore the policy which tends to create a standard of values devoid of profit to all but the consumer, and even of questionable utility to him.

DECORATION DAY SENSATIONALISM.

No finer, no nobler, sentiment can exist than that which we, as a people, recognize and cherish on Decoration Day. It is a sentiment that does honor to the living heroes of a great national episode, while it glorifies the valor of their dead comrades. The cause that was lost and the cause that was won, alike become more sacred on such a day; while the patriotism of a united people and of a solidified nation glows warmer and stronger with the revived memory of the peril and privation and bereavement gone through.

It would seem fitting to preserve such a pathetic commemoration solely for the lofty purpose that first inspired it, but they who seek notoriety will not have it so. The Rev'd Dr. Wellman, of Brooklyn, has actually prostituted it by organizing special Decoration Day services for the "Trolley Victims" in that city; and with hymns and flowers and perfervid drivel has set a fashion the vogue of which can but add new terrors to death and new horrors to life.

If it be true that there are over 100 "victims of the trolley" in Brooklyn, why, we would ask, is it that they should be thus vulgarized and advertised as different from other dead? A large number of them were, alas, victims of their own stupidity and folly, and many of the others would have escaped were the cars provided with decent brakes or fenders. We do not grudge them the songs and flowers, but is it not the height of maudlin, rotten sentimentality thus to deal with the correction of such accidents? Many of the Brooklyn divines are, in fact, letting themselves loose in a curious way over this subject. But the other day, a well known Congregational minister raved about putting all the street railroads into municipal or state ownership. And yet his ancestors, founders of our great Republic, crossed the stormy Atlantic in cockleshells to escape at any risk from the evils of the state and municipal control he would now restore.

If the Wellman plan takes root, we shall have Decoration Day given up to the memory of victims of the steam railroads, of boiler explosions, of gas explosions, of steamboat collisions, of bicycle runovers, of football fatalities, and heaven knows what else. We shall have the temperance societies decorating the graves of all the drunkards untimely killed by alcohol; and sanitary societies holding services over the victims of diphtheria, scarlet fever and typhoid—victims assuredly of bad city government, rather than of "corporation greed."

Moreover, the theory of the Wellman plan is all wrong. We are told that the trolley is deadly—because it is the trolley. Now, to say nothing of the frequent fatal accidents with the horse car and the cable, it may be noted that the conduit electric road in New York, not yet in regular operation, is already beginning to register its "victims." Dr. Wellman will be losing glorious chances of sensational notoriety if he does not take immediate steps to include these victims in his next celebration.

ELECTRIC LAUNCHES.

The time of year has arrived when aquatic amusements receive their share of attention, and when once again, the electric launch has a chance to demonstrate its many excellent qualities. Last year, owing to the prominence given to electric launches by one or two wealthy sportsmen at Newport, the public was induced to take an interest in the subject; but the electric launch can never be wholly or fully popular until everybody has a chance to try it for himself. There are some things that necessarily remain above popular reach, such as the ownership of race horses or the enjoyment of steam yachting; but there is little fun in boating unless you can take a hand at it yourself.

The way to meet the necessity of the hour has, we think, been cleverly pointed out by Mr. Hickley, to whose work we call attention elsewhere in this issue. Mr. Hickley has devised and fitted up, at low cost a type of boat that is certainly well within popular reach, and which, if not owned, can be hired from a hotel or resort of similar nature near the water. A boat of such size and draught needs little power, but will easily carry several passengers and will yield many a pleasant hour at slight outlay, whether the battery be primary or secondary.

While the World's Fair type of launch marks the highest point yet attained in the handling of large water traffic electrically, we cannot but think that electrical boats for the million, to compete with row boats, catboats and naphtha launches, must be of this Hickley type, and even of the smaller class devised by Mr. J. C. Chamberlain in which oar and propeller are both available. Be this as it may, a large field of work is here open to electric boat building concerns and to supply houses in different parts of the country ready to seize new and profitable opportunities.

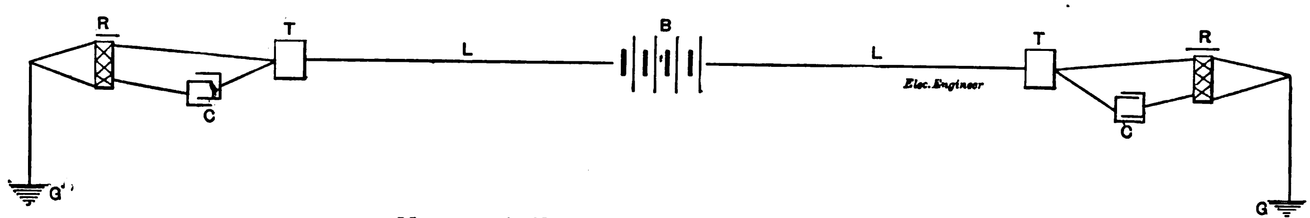
Telephony.

THE MARSHALL NON-INDUCTIVE TELEPHONE SYSTEM.

In all existing telephone systems for underground or long distance telephony, it is necessary for the practical working of magneto-electric apparatus that metallic circuits be used in order to overcome the induction and capacity effects of the circuits.

In a system recently devised by Mr. Wm. Marshall, of New York city, the metallic circuit with its accompanying expensive adjuncts is not necessary.

The cut shows a circuit equipped on the Marshall system. There is no induction coil in the transmitter, as direct current transmission is employed, and as is well known electrostatic capacity does not limit the transmission of direct current signals in the same measure as it does that of induced currents; a glance at the figure will show how induced currents are neutralized. The receiver R is provided with two coils wound in opposite directions, one coil being connected to the earth and line direct, the other coil to earth and through condenser C to line. Therefore the induced currents, coming in on the line are divided, half passing through the condenser and coil to the earth, and half passing through the other coil to earth, and the coils being wound in opposite directions counteract each other, thus having no effect on the diaphragm; on the other hand, direct current signals coming in on the line cannot pass through the condenser, therefore traverse only one coil of the receiver and thus reproduce all signals from the sending station.



Marshall's Non-Inductive Telephone System.

One advantage gained by the use of this system is the reduction and centralization of the battery power necessary for an exchange system, all the battery being located at the central station, there being no battery at the subscriber's end of the line. A careful and conservative estimate for exchange work places the necessary battery at less than one-third the number of cells used in existing systems. There is nothing at the subscriber's end to get out of order, as the specially designed transmitter for direct current working is permanently adjusted. In Mr. Marshall's new transmitter, we are informed, there are no electrodes and it operates on the principle of cutting in and out resistance in an electric circuit. The other working parts are said to be very simple and when once adjusted require no further attention.

This system is also claimed to be especially valuable for long distance work, as it does not require two heavy copper wires for each circuit and does not depend upon a limited amount of induced current for the transmission of speech, for when the limit of transmission has been found with a given line and battery all that is necessary to increase the volume of sound is to increase the battery power; therefore as long the wire remains intact transmission of speech is insured.

For duplex telephony in connection with the foregoing direct current circuit, the Marshall condenser telephone system is admirably adapted.

Tallahassee, Fla.—Messrs. George W. Saxon, W. A. Rawls, James D. Randall and M. B. Rice have applied for a charter, as the Florida Telephone and Construction Company, with a capital of $10,000 and headquarters at Tallahassee.

Waterloo, Ia.—The Waterloo and Cedar Falls Telephone Company has filed articles of incorporation with the secretary of state. The principal place of business is Waterloo and the capital stock is $15,000. The incorporators are: John H. Leavitt, C. O. Balliett, G. G. Bickley, C. F. Bennett, F. C. Platt, S. B. Humbert, Roger Leavitt, W. H. Hartman and C. P. Brotnober.

Ft. Wayne, Ind.—The Harrison Telephone Company has abandoned its service and forfeited its valuable franchises at Terre Haute. The franchise which the Harrison Company held in Fort Wayne for a time has reverted to the original Fort Wayne Company, consisting of Messrs. W. P. Breen, Edward Gilmartin and R. T. McDonald. It is said that it will begin the work of putting in a complete telephone service at the same terms and under the same contracts as those made by the Harrison Company.

AMERICAN BELL TELEPHONE OUTPUT.

The Bell Telephone instrument statement for the month ended May 20, shows:

	1895	1894	Inc.	Dec.
Gross output........	18,149	8,974	9,175	......
Returned	6,958	5,310	1,648	......
Net output........	11,191	3,664	7,527	......
Since Dec. 20:				
	1894-5	1893-4	Inc.	Dec.
Gross output........	68,306	31,899	36,407	......
Returned............	32,183	28,379	3,804	......
Net output........	36,123	3,520	32,603	......
Total outstanding....	618,629	570,011	48,618	......

A TELEPHONIC STEAM WHISTLE ATTACHMENT.

Manager Fowler, of the telephone exchange, at Ashland, Ky., has devised an ingenious attachment for telephones to be used in factories and shops where the amount of noise makes it almost impossible to hear the call bell of the instrument. It consists of a steam whistle which is turned on by means of a lever operated by magnetism. When the instrument is called from the exchange, the bell rings as usual, and by the electric current passing through a magnet a weight is released which pulls the lever to the whistle. Once started, the whistle keeps up its shrill note until some one answers the call and turns off the steam, which is done by simply replacing the weight.

One of these attachments is being placed at the local steel plant, another at the tannery, and several more will probably be installed in sawmills and similar establishments.

TELEPHONE NOTES.

Salem, Ore.—The Oregon Telegraph and Telephone Company has begun the improvement of its telephone system in Salem.

High Point, N. C.—The Southern Telephone Co., of Fayetteville, is equipping a telephone exchange at High Point.

Mexia, Tex.—Chas. R. Pengilly, of Corsicana, is organizing a telephone exchange.

Cincinnati, O.—The Devere Electric Telephone and Fire Alarm Company has asked permission to erect poles and apparatus in the city.

Lake City, Mich.—A telephone line is to be constructed between Lake City and McBain. Gillis McBain and C. O. Dunham will build it as an investment.

Bartlett, Tex.—The Southwestern Telephone Company has opened up business and has connection with nearly all cities in the State.

Silver Creek, N. Y.—A stock company has been formed to build and operate a telephone line between the villages of Silver Creek, Smith Mills, Irving and Forestville.

Owensboro, Ky.—The preliminary steps have been taken for the organization of the Harrison Telephone Company. Work will be commenced soon on the construction of an exchange. The capital stock is $20,000 and will be furnished by local people. The new company announces a rate of $30 a year for business houses and $18 for residences.

Kansas City, Mo.—The Interstate Long Distance Telephone Company has been formed; capital stock, $100,000. Directors: W. T. Hewett, W. N. Tott, J. W. Fogler, Alexander Rothenber and L. P. Rothschild, all of Leavenworth. The purpose of the organization is to build telephone lines between Kansas towns and elsewhere.

Sioux City, Ia.—The articles of incorporation of the Home Telephone Company have been filed. The incorporators are A. H. Hazen, A. F. Call, F. L. Eaton, T. H. Johnson, G. H. Hollister, W. T. Honsinger, R. M. Dott, F. A. Dwinnell and F. W. Lohr. The capital stock of the company is $70,000. Until the first annual meeting in December the officers will consist of Arthur H. Hazen, president; T. H. Johnson, vice-president; R. M. Dott, secretary and George H. Hollister, treasurer.

SALE OF THE DIRIGO CO. TO THE NEW ENGLAND BELL.

The Dirigo Telephone Company, organized by well-known Augusta, Me., business men, has sold its wires, equipment and good will to the New England Telephone Company, its competitor, which gives the Bell people control of the whole field. The price is not mentioned, but it is a good figure. The Dirigo Company opened for business three months ago and at this time has 140 subscribers. The annual rental was fixed at $25 for each telephone. The New England company at once came down from $42 to $18 and will continue this rate until November 1st. It is said that the sale of the Dirigo was made for fear of infringement of the Berliner patent.

TELEPHONY IN THE DOMINION.

John Starr, Son & Co., of Halifax, N. S., have just been awarded the contract for installing a complete telephone exchange for fifty subscribers at Campbellton, N. B., including switchboard, telephones, wires, etc. Messrs. Starr have also just received an order through their Quebec agents for five standard switchboards with the necessary telephones, etc. This speaks well for the superiority of the "Unique" telephones, manufactured by them, as in both instances the above were secured in face of strong competition. This firm have made a specialty of telephones for some time, and their makes are well and favorably known all over Canada.

TELEPHONE NOTES.

FLORENCE, COL.—A franchise has been granted by the city council to the Colorado Telephone company.

DUBUQUE, IA.—The Wizard Telephone & General Electric Mfg. Co. proposes to establish a telephone system in this city.

MACOMB, ILL.—A telephone franchise has been granted to the Western Illinois Telephone Company for 15 years.

CEDAR FALLS, IA.—The Cedar Falls council granted a fifteen year franchise to the Cedar Falls and Waterloo Telephone Co.

SOMERSET, MD.—A telephone company has been organized in Somerset, with H. Fillmore Lankford as president.

MICHIGAN CITY, IND.—The Strowger Automatic Telephone Exchange of La Porte has been sold to the Merchants' Mutual, of Michigan City.

YPSILANTI, MICH.—C. M. Upton, president of the Michigan Automatic Telephone Co. has given out as final that the system will be completed by July 1.

GRAND RAPIDS, WIS.—The Wood County Telephone company has been formed; capital, $5,000: incorporators, John A. Gaynor, H. H. Voss and George L. Williams.

CHILLICOTHE, O.—The following have been elected officers for the Home Telephone Co.: President, Judge James M. Thomas; vice president, David Auch; treasurer, John H. Blacker; secretary, Frank Harper; manager, A. H. Reutinger.

CRISFIELD, MD.—A telephone company with headquarters at Princess Anne, has recently been incorporated, with H. Fillmore Lankford, president; H. L. Brittingham, vice-president, and Thomas H. Back secretary and treasurer.

PARSONS, KAS.—Fred H. Brown, son of Col. Ed. Brown, of Galena, is in the city representing the Hunning Long Distance Telephone Company, with the view of putting the system in operation in Parsons.

TIFFIN, O.—The City Council has granted the Tiffin Telephone company a franchise for operating a telephone exchange in this city. The franchise was granted to Winfield S. Wagner, Harrison H. Noble and Charles E. Derr.

HUNTSBURGH CENTRE, O.—Geo. W. Pease and others have incorporated the Geauga County Telephone and Electric Co., of Huntsburgh Centre, Geauga Co., to build and operate a telephone line from Huntsburg Centre to Chardon; capital, $2,000.

SYCAMORE, ILL.—The DeKalb County Telephone company has elected a board of six directors and the following are officers: President, W. H. Rogers; Vice president, E. Rogers; Secretary and Treasurer, Frank O. VanGalder. Construction will be commenced at once on a local telephone exchange in Sycamore.

LOCKLAND, O.—A number of the leading merchants in the Millcreek Valley are agitating the matter of establishing a local telephone system to include the villages of Elmwood Place, Carthage, Hartwell, Maplewood, Lockland, Wyoming and Reading. The main office is to be situated at Lockland.

WESTMINSTER, MD.—The Western Maryland Telephone Company of Carroll county, Md., has been granted exclusive right for ten years to use the streets and alleys of Westminster, for telephone purposes, and the County Commissioners have given the company the use of the public highways.

FALL RIVER, MASS. has granted the Southeastern Telephone Co. permission to bury their wires.

NASHVILLE, TENN.—The Forked Deer Telephone Company is being organized for the purpose of building a telephone line from Bell's to Alamo and thence to some point on the C. & O. Railroad.

SUSQUEHANNA, PA.—The Metropolitan Telephone Company has been organized by business men, with E. W. Jackson and A. W. Cook in the lead. This will give Susquehanna two independent telephone companies.

FRANKFORT, IND.—The Frankfort Telephone Company has been formed; capital, $15,000; directors, Relief Jackson, Thomas Scantlin, William B. Kramer, James McClamrock, David A. Coulter, John C. Shanklin and James A. Hedgcock.

SAGINAW, MICH.—J. E. Keelyn, president of the Western Telephone Construction Company, of Chicago, has closed a deal with W. F. Stevens, of this city, for 20,000 poles and bought all the poles he could find on the Huron shore between Saginaw and Alpena.

WHITE BEAR, MINN.—The White Bear Telephone Company have been organized and will make every endeavor to have their plant ready for business by June 1. The lines will take in Cottage Park, Lake Shore, White Bear, Bald Eagle, Dellwood and Mahtomedi.

TRINIDAD, COL.—John F. Sherman, Fred Wardenburg, A. Mansbach, J. H. Mayhew, John T. Hughes, Sol H. Jaffa, Z. E. Funk, F. E. Griswold and C. V. Turner, all of Trinidad, have organized the Citizens' Telephone company to operate in Las Animas and other counties. The capital stock is $15,000.

WEIMAR, TEX.—Charles Brieger and Sam Griffin have obtained the contract to put up a telephone line from Ammannville, about ten miles from here, to Holman, about seven miles from Weimar, thus giving Weimar telephone connection with Ammannville via Holman.

RICHMOND, VT.—The Richmond & Huntington Telephone Company recently met and organized under the laws of Vermont. The following officers were elected for one year: A. E. Ellis, president; F. B. Gillett, W. E. Hanks, directors; A. Hanks, auditor; J. C. Sabens, secretary.

WINNSBORO, S. C., and Ridgeway, twelve miles apart, are soon to have telephonic communication if the plans of the Winnsboro and Ridgeway Telephone Company are carried out. That company has applied to the Secretary of State for a charter. The capital stock is $800. The corporators are: W. D. Douglass, J. Q. Davis, M. W. Doty and E. C. Heins.

ASHLAND, PA.—An important meeting of the newly organized Schuylkill Telephone Company has been held. It will connect all the towns between Pottsville and Sunbury. The permanent officers for the ensuing year were elected as follows: President, Edwin C. Price, Ashland; treasurer, Edw. Hunter, Shenandoah; secretary, E. C. Wagner, Girardville.

STATEN ISLAND, N. Y.—The following have been elected officers of the Automatic Telephone Company, which proposes to erect a line on the East and North shores: President, James Kerr; Treasurer, J. Walter Wood; Secretary, A. J. Hinton; directors, J. W. Allison, J. C. McGuire, C. C. Pucci, G. W. King, and F. W. Kerr.

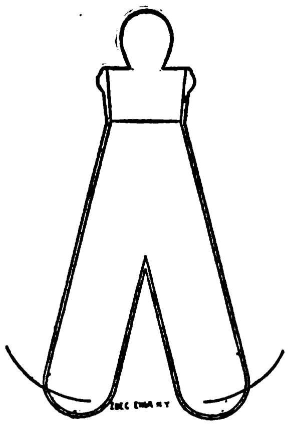
UTICA, N. Y.—The Baxter Telegraph and Telephone Company has held its annual meeting. The following are the officers: President, Charles W. Mather; vice-president, James B. Turnbull; secretary, Andrew W. Mills; treasurer, T. Jay Griffiths; executive committee, Palmer M. Wood, Herkimer; Countcil Munson, Louis Fride, Utica. The company is "to be heard from" soon.

STEUBENVILLE, O.—The Phœnix Telephone Company of the cities of Steubenville and New Cumberland has been granted a charter under the laws of West Virginia, in the names of S. P. Quick, G. G. Gaston, E. T. Wells, J. A. McCullough and Geo. A. Maxwell. The capital stock is $30,000, of which $600 has been subscribed. G. G. Gaston is Treasurer. The charter is granted for a period of 50 years.

JONESBORO, TENN.—The Nolachucky Telephone Company has been formed to operate a telephone system, and will make Jonesboro, Tenn., the central office. Charles Seymour, of Knoxville, Guy R. Johnson, general manager of the Embreeville Iron Company, Capt. A. S. Deadrick, J. H. Epps and W. P. Brownlow are the charter applicants of the company. The franchise embraces Jonesboro and Johnson City.

TICONDEROGA, N. Y.—The Ticonderoga Telephone Co. has been formed to maintain and operate a line of telephone from Addison Junction to Rogers' Rock Hotel, Street Road, Crown Point, Port Henry, Chilson, Schroon Lake, Whitehall, Hague, Bolton, Caldwell and Glens Falls; capital, $5,000; and directors, W. W. D. Jeffers, W. I. Higgins, O. B. Bascom, D. C. Bascom, E. J. Owen, F. L. Brust, A. R. Wood, C. H. Delano and S. W. Hyde, all of Ticonderoga, Essex County.

SPECIFICATIONS FOR THE PRACTICAL APPLICATION OF THE DEFINITIONS OF THE LEGAL AMPERE AND VOLT.



Standard Cell.

Last July Congress passed an act legalizing the electrical standard as adopted at the Chicago International Congress of Electricians, delegating to the National Academy of Sciences the duty of drawing up specifications for the practical application of the two principal units, the ampere and the volt.

The Academy recently submitted its report to Congress, and we give below the specifications adopted. The report was drawn up by the following committee: H. A. Rowland, chairman; H. L. Abbott, G. F. Barker, C. S. Hastings, A. A. Michelson, J. Trowbridge and C. Barnes. In order to have the specifications accord with international usage, free use was made of the English Government specifications and of certain papers prepared by Dr. K. Kahle of Germany, and Prof. H. S. Carhart of this country.

SPECIFICATION A.—*The Ampere.*

In employing the silver voltameter to measure currents of about one ampere, the following arrangements shall be adopted:

The kathode on which the silver is to be deposited shall take the form of a platinum bowl not less than 10 centimeters in diameter, and from 4 to 5 centimeters in depth.

The anode shall be a disc or plate of pure silver some 30 square centimeters in area and 2 or 3 millimeters in thickness.

This shall be supported horizontally in the liquid near the top of the solution by a silver rod riveted through its center. To prevent the disintegrated silver which is formed on the anode from falling upon the kathode, the anode shall be wrapped around with pure filter paper, secured at the back by suitable folding.

The liquid shall consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water.

The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

Method of making a measurement.—The platinum bowl is to be washed consecutively with nitric acid, distilled water and absolute alcohol; it is then to be dried at 160° C., and left to cool in a desiccator. When thoroughly cool it is to be weighed carefully.

It is to be nearly filled with the solution and connected to the rest of the circuit by being placed on a clean insulated copper support to which a binding screw is attached.

The anode is then to be immersed in the solution so as to be well covered by it and supported in that position; the connections to the rest of the circuit are then to be made.

Contact is to be made at the key, noting the time. The current is to be allowed to pass for not less than half an hour, and the time of breaking contact observed.

The solution is now to be removed from the bowl and the deposit washed with distilled water and left to soak for at least six hours. It is then to be rinsed successively with distilled water and absolute alcohol and dried in a hot air bath at a temperature of about 160° C. After cooling in a desiccator it is to be weighed again. The gain in mass gives the silver deposited.

To find the time average of the current in amperes, this mass, expressed in grams, must be divided by the number of seconds during which the current has passed and by 0.001118.

In determining the constant of an instrument by this method, the current should be kept as nearly uniform as possible and the readings of the instrument observed at frequent intervals of time. These observations give a curve from which the reading corresponding to the mean current (time average of the current) can be found. The current, as calculated from the voltameter results, corresponds to this reading.

The current used in this experiment must be obtained from a battery and not from a dynamo, especially when the instrument to be calibrated is an electrodynamometer.

SPECIFICATION B.—*The Volt.*

Definition and properties of the cell.—The cell has for its positive electrode, mercury, and for its negative electrode, amalgamated zinc; the electrolyte consists of a saturated solution of zinc sulphate and mercurous sulphate. The electromotive force is 1.434 volts at 15° C., and between 10° C. and 25° C., by the increase of 1° C. in temperature, the electromotive force decreases 0.00115 of a volt.

1. *Preparation of the mercury.*—To secure purity it should be first treated with acid in the usual manner and subsequently distilled *in vacuo*.

2. *Preparation of the zinc amalgam.*—The zinc designated in commerce as "commercially pure" can be used without further preparation. For the preparation of the amalgam one part by weight of zinc is to be added to nine (9) parts by weight of mercury and both are to be heated in a porcelain dish at 100° C. with moderate stirring until the zinc has been fully dissolved in the mercury.

3. *Preparation of the mercurous sulphate.*—Take mercurous sulphate, purchased as pure, mix with it a small quantity of pure mercury and wash the whole thoroughly with cold distilled water by agitation in a bottle; drain off the water and repeat the process at least twice. After the last washing, drain off as much of the water as possible. (For further details of purification, see Note A.)

4. *Preparation of the zinc sulphate solution.*—Prepare a neutral saturated solution of pure re-crystallized zinc sulphate, free from iron, by mixing distilled water with nearly twice its weight of crystals of pure zinc sulphate and adding zinc oxide in the proportion of about 2 per cent. by weight of the zinc sulphate crystals to neutralize any free acid. The crystals should be dissolved with the aid of gentle heat, but the temperature to which the solution is raised must not exceed 30° C. Mercurous sulphate, treated as described in 3, shall be added in the proportion of about 12 per cent. by weight of the zinc sulphate crystals to neutralize the free zinc oxide remaining, and then the solution filtered, while still warm, into a stock bottle. Crystals should form as it cools.

5. *Preparation of the mercurous sulphate and zinc sulphate paste.*—For making the paste, two or three parts by weight of mercurous sulphate are to be added to one by weight of mercury. If the sulphate be dry, it is to be mixed with a paste consisting of zinc sulphate crystals and a concentrated zinc sulphate solution, so that the whole constitutes a stiff mass, which is permeated throughout by zinc sulphate crystals and globules of mercury. If the sulphate, however, be moist, only zinc sulphate crystals are to be added; care must, however, be taken that these occur in excess and are not dissolved after continued standing. The mercury must, in this case also, permeate the paste in little globules. It is advantageous to crush the zinc sulphate crystals before using, since the paste can then be better manipulated.

To set up the cell.—The containing glass vessel, represented in the accompanying figure, shall consist of two limbs closed at bottom and joined above to a common neck fitted with a ground glass stopper. The diameter of the limbs should be at least 2 centimeters and their length at least 3 centimeters. The neck should be not less than 1.5 centimeters in diameter. At the bottom of each limb a platinum wire of about 0.4 milimeter diameter is sealed through the glass.

To set up the cell, place in one limb pure mercury and in the other hot liquid amalgam, containing 90 parts mercury and 10 parts zinc. The platinum wires at the bottom must be completely covered by the mercury and the amalgam, respectively. On the mercury, place a layer one centimeter thich of the zinc and mercurous sulphate paste described in 5. Both this paste and the zinc amalgam must then be covered with a layer of the neutral zinc sulphate crystals one centimeter thick. The whole vessel must then be filled with the saturated zinc sulphate solution, and the stopper inserted so that it shall just touch it, leaving, however, a small bubble to guard against breakage when the temperature rises.

Before finally inserting the glass stopper, it is to be brushed round its upper edge with a strong alcoholic solution of shellac and pressed firmly in place. (For details of filling the cell, see Note B.)

NOTES TO THE SPECIFICATIONS.

(*A.*) *The mercurous sulphate.*—The treatment of the mercurous sulphate has for its object the removal of any mercuric sulphate which is often present as an impurity.

Mercuric sulphate decomposes in the presence of water into an acid and a basic sulphate. The latter is a yellow substance—turpeth mineral—practically insoluble in water; its presence, at any rate in moderate quantities, has no effect on the cell. If, however, it be formed, the acid sulphate is also formed. This is soluble in water and the acid produced affects the electromotive force. The object of the washings is to dissolve and remove this acid sulphate and for this purpose the three washings described in the specification will suffice in nearly all cases. If, however, much of the turpeth mineral be formed, it shows that there is a great deal of the acid sulphate present and it will then be wiser to obtain a fresh sample of mercurous sulphate, rather than to try by repeated washings to get rid of all the acid.

The free mercury helps in the process of removing the acid, for the acid mercuric sulphate attacks it, forming mercurous sulphate.

Pure mercurous sulphate, when quite free from acid, shows on repeated washing a faint yellow tinge, which is due to the formation of a basic mercurous salt distinct from the turpeth mineral, or basic mercuric sulphate. The appearance of this primrose yellow tint may be taken as an indication that all the

acid has been removed; the washing may with advantage be continued until this tint appears.

(B.) *Filling the cell.*—After thoroughly cleaning and drying the glass vessel, place it in a hot water bath. Then pass through the neck of the vessel a thin glass tube reaching to the bottom to serve for the introduction of the amalgam. This tube should be as large as the glass vessel will admit. It serves to protect the upper part of the cell from being soiled with the amalgam. To fill in the amalgam, a clean dropping tube about 10 cms. long, drawn out to a fine point, should be used. Its lower end is brought under the surface of the amalgam heated in a porcelain dish, and some of the amalgam drawn into the tube by means of the rubber bulb. The point is then quickly cleaned of dross with filter paper and is passed through the wider tube to the bottom and emptied by pressing the bulb. The point of the tube must be so fine that the amalgam will come out only on squeezing the bulb. This process is repeated until the limb contains the desired quantity of the amalgam. The vessel is then removed from the water bath. After cooling, the amalgam must adhere to the glass and must show a clean surface with a metallic luster.

For insertion of the mercury, a dropping tube with a long stem will be found convenient. The paste may be poured in through a wide tube reaching nearly down to the mercury and having a funnel-shaped top. If the paste does not move down freely it may be pushed down with a small glass rod. The paste and the amalgam are then both covered with the zinc sulphate crystals before the concentrated zinc sulphate solution is poured in. This should be added through a small funnel, so as to leave the neck of the vessel clean and dry.

For convenience and security in handling, the cell may be mounted in a suitable case so as to be at all times open to inspection.

In using the cell, sudden variations of temperature should, as far as possible, be avoided, since the changes in electromotive force lag behind those of temperature.

LITERATURE.

Elementary Problems in Current Electricity for Technical Students. By Jas. E. Boyd and Newton H. Brown. Columbus, Ohio, 1895. H. E. Brown & Sons. 42 pp., 4½ x 6½. Flexible Cover. Price, 35 cents.

THIS is a collection of questions grouped under the various heads illustrating the application of the various formulæ for calculating resistance, the application of Ohm's law, electrostatic capacity, magnetic and other current effects. Under each chapter heading, the authors name the articles in standard educational works, in which can be found the methods and formulæ necessary for working out the results. In order to enable the student to verify his work, the answers to the questions are also given at the end. The book ought to prove useful in the hands of both teachers and students, affording the former a variety of questions ready at hand.

Der Weltverkehr. (The World's Traffic). By. G. Freytag. 1895. G. Freytag and Berndt, Vienna. Price, 75 cents.

This chart is a most carefully prepared compendium of the railroad, steamship, telegraph and cable lines of the world, including depths of the ocean. To this is added a large amount miscellaneous information, consisting of postal and telegraph rates, and the time required in transit, and statistical diagrams of relative size, number of inhabitants, land under cultivation, etc., of all the countries of the world. This compilation will be found most valuable to all engaged in commerce, whether domestic or foreign.

Mechanical Engineer's Pocket-Book. By Wm. Kent, A. M., M. E. New York, 1895. John Wiley & Sons. 1,087 pp. Pocket size. Price, $5.

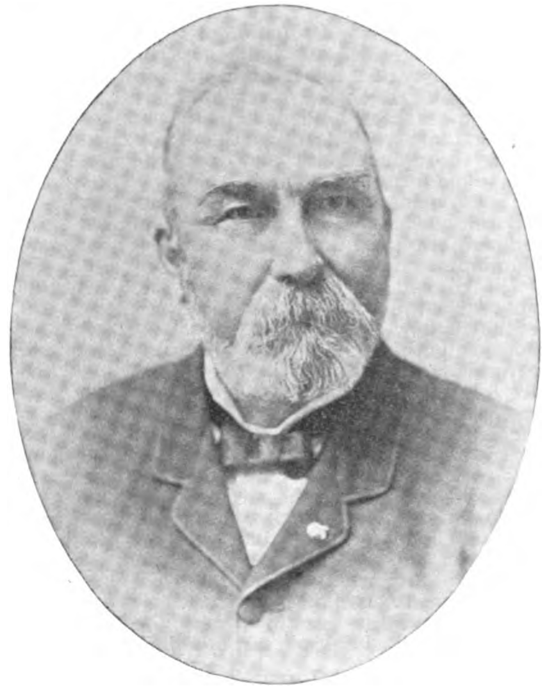
MR. KENT has given us in this book a collection of modern data relative to the mechanical engineer's work, and hence of special value to the electrical engineer whose work touches the other so closely. Indeed, the author has recognized the growing application of electricity to the mechanical engineer's field by devoting a representative amount of space to electrical data. The work has been very carefully prepared and will prove of value to the electrical engineer.

WE have received from B. Egger & Co., of Vienna, a handsomely printed brochure illustrating the electric railway built by that enterprising firm at Gmunden. The road is built on the overhead trolley system, and is 2.5 kilometres long. At the present time three motor cars are in operation, one of which is equipped with a baggage compartment.

PERSONAL.

CAPT. SAMUEL TROTT—OF THE ANGLO-AMERICAN TELEGRAPH CO.'S CABLE STEAMSHIP "MINIA."

The career of a man of whom it is said: "He knows the bottom of the Atlantic and the position of every cable as well as a cabman knows the streets of a city" is sure to present many points of characteristic interest. Captain Samuel Trott, of the Anglo-American Telegraph Company's cable steamship "Minia," who has earned this reputation, and whose valuable paper on submarine cables was recently published in THE ELECTRICAL ENGINEER, was born in 1832 in the county of Sussex, England, where he received his early education. When he was about fifteen years of age, his parents returned to their native county of Devonshire, and there the budding sailor went through a full course of navigation and astronomy, as a preparation for the life of his choice. At the age of seventeen he was apprenticed to the sea for a four years' term, but long before its expiration he was put in charge of a watch, the captain having recognized his sterling qualities at this early stage of his seafaring life. Sturdy and reliable in every branch of his duties, he soon showed that he was destined to forge to the front rank of his calling. In his twenty-seventh year he was placed in command of a sailing ship. He had,



CAPT. SAMUEL TROTT.

however, got his foot on the ladder, and this position did not long engage his services. The command of a large steamer of an important line became vacant, and Capt. Trott was promptly given the appointment. During the next 10 years he commanded some of the finest mail and passenger steamers of the day, and has crowds of friends on both sides of the Atlantic who cherish pleasant memories of the voyages they made under his care. It is, however, in the Atlantic Telegraph Cable service that he has made his name famous. In the year 1874 he took charge of the cable steamer "Faraday," in which he remained for six years. During that time he laid the Direct and French Companies' cables. In the winter of 1875–6 he distanced all records in cable repairing. He crossed the Atlantic three times, and made three repairs for the Direct Cable Company. In telegraph circles this was looked upon as a remarkable feat, as up to that time it was considered impossible to repair Atlantic cables in the stormy season between the months of October and May. These and other notable achievements in cable work naturally attracted the attention of that able manager and director, the late Henry Weaver, of the Anglo-American Company, and in 1880 the services of Capt. Trott were secured by him for the "Minia." He has now commanded this ship for 15 years, during which time he has made a reputation in cable repairing work which places him at the top of the profession. His motto is, "Never fail," and how well he has lived up to it is shown by the fact that within the last ten years the "Minia" has made about 120 repairs without a single failure, although many of the repairs were in the deepest ocean water, one even reaching the enormous depth of 2,597 fathoms! This was accomplished after

a ship nearly double the size of the "Minia" had spent four months in attempting the same work and had failed.

Capt. Trott is of a distinctly inventive turn of mind. He holds several valuable patents, some of which promise to be carried to practical development in the near future; and curiously enough they deal with electric railway work, as well as with submarine cable manufacture and repair. Capt. Trott is a typical Devon sailor. A man of strong individuality, he is a strict disciplinarian, but with all who have ever known him his name is also a synonym for staunchness, kindliness of heart and integrity.

MR. J. CHESTER CHAMBERLAIN, the well-known electrical engineer and expert, is to be married on June 12, at Greenbush Heights, Albany, N. Y., to Miss Anna Mary, daughter of Mrs. William P. Irwin.

MR. J. DAY FLACK, M. E., of 252 W. 85th St., New York, for ten years the mechanical and electrical engineer of the General Electric Lamp Works at Harrison, N. J., has branched out for himself and will now undertake general consulting, designing and supervising work both electrical and mechanical. Mr. Flack will pay particular attention to the supervising of electrical work for architects, the laying out of electric steam plants, wiring work, etc. He will also make reports on inventions.

THE REDUCTION OF REFRACTORY METALS.

Under the title of "The Reduction of the Rarer Metals from their Oxides," Prof. Roberts-Austen has just concluded a series of lectures at the Society of Arts, London. At present three distinct methods of reducing refractory metals are in use.

The first of these three methods in point of antiquity, general applicability and inherent interest, is the purely chemical process of performing the reduction in two or more steps, some intermediate compound forming the stepping stone. The most familiar illustration is the reduction of aluminum from alumina *via* aluminum chloride. Carbon will not reduce alumina at ordinary furnace temperatures; sodium is also ineffective; carbon will not reduce aluminum chloride. But carbon in the presence of chlorine will convert alumina into aluminum chloride, and sodium will reduce this latter with ease.

The second method is noteworthy for its extreme neatness and simplicity, and the certainty that the reducing agent will not introduce foreign matter into the reduced product. It is, of course, electrolysis. Unfortunately, as the metals to be reduced are *ex hypothesi* refractory, they cannot be dealt with in aqueous solution until someone has discovered a new kind of water less readily electrolyzed than the ordinary variety. The adoption of fused baths presents many difficulties, largely arising from the attack of the vessels in which the electrolysis is carried out; but that these are not insuperable is proved by the flourishing state of the aluminum industry, the bulk, if not the whole, of which now depends on the electrolysis of alumina or its salts. It is here that the utility of aluminum sulphide is shown, for although its chemical reduction is difficult, its electrolysis can be accomplished, and presents certain advantages over that of the oxide dissolved in a fused halogen salt of aluminum, which is the more usual electrolyte.

The third general method is that involving the employment of the electric furnace. On account of the high fusing point and boiling point of carbon, this element can be trusted to stay at its post by the refractory oxide until a temperature is reached at which reduction of the oxide takes place. When once this is accomplished the carbon escapes as the gaseous oxide CO, and reverse reaction is thus minimized. But the very merit of carbon is the bane of the process when a pure metallic product is required. At the high temperatures requisite for reduction, carbides of great stability are formed and from these the pure metal can only be obtained by repeated fusion with the oxide of the metal under treatment, in order to successively oxidize portions of the carbon by an oxidant from its nature incapable of reacting upon the metal itself. The *rationale* of the action of the electric furnace in reducing refractory metals is totally distinct from that of the electrolysis performed upon a fused salt of the same refractory metal. The latter is, above all, as systematic and selective as the former is chaotic and indiscriminate. Each serves special ends.

ELECTRICAL ACTIVITY AT ATCHISON, KAN.

The Atchison Railway, Electric Light & Power Co., N. P. Waggener, president, has been organized, with a capital stock of $300,000, for railway work, electric light and power. The systems used are the Brush arc and the La Roche alternating. It has five dynamos supplying 130 arcs, and 4,000 incandescents and has about 60 miles of circuits, including city lights. It has one 600 Sioux City Corliss engine and two of the same make of 300 H. P. each. It is just starting its power circuit for motor work. It is running 8 motor cars, with 4 trailers when necessary. It is in the market every month for material for the constant extension of its electric light service. The power house is of brick.

THE BRUSH CO. AND THE SWAN LAMP.

The Brush Electric Company has recently purchased the property of The Swan Lamp Manufacturing Company and will manufacture and sell incandescent lamps. The Swan lamp is well-known throughout the world, not only because it bears the name of the celebrated Electrican, Joseph Swan, but because it is widely used in many foreign countries. The Swan Lamp Manufacturing Company was organized in 1885 and has, until its purchase by the Brush Company, rented factory room from The Brush Electric Company.

The Brush Electric Company's going into the manufacture of incandescent lamps, is a new departure. The new incandescent lamp department of the Brush Company, will be under the direct supervision of the Superintendent and Assistant Superintendent, but will be operated by a foreman who has had a long experience in the manufacture of incandescent lamps. The sale of the incandescent lamps and the handling of the business will be done by the different departments of the Brush Company.

METHODS OF STORAGE BATTERY INSTALLATION.

CATALOGUE "B," just issued by the Electric Storage Battery Co., of Philadelphia, is a publication of more than usual value, and is of particular interest at this time, now that the utility of storage batteries is being more generally recognized. Within its covers we find described the various types and sizes of the Chloride cells, ranging from 3 x 3 inch plates, with a normal capacity of 6¼ ampere hours, to 15½ x 15½ inch plates, with a cell having a capacity of 5,000 ampere hours. We also find a number of designs for battery stands, illustrated by working drawings. They are constructed both of wood and of iron; together with standard switch boards, reserve cells, switches, current equalizers, automatic switches and auxiliary apparatus required in storage battery work, together with instructions for the setting up and using of the Chloride accumulator, with sulphuric acid tables.

Among other interesting information contained in the catalogue are a variety of diagrams of connections, to suit different conditions of working, which will prove of value to all interested in this branch of electricity. The one shown in Fig. 1, taken from the Catalogue, illustrates the method of connecting up, also the arrangement of switchboard, for adding a storage battery equipment to an existing plant, the increased E. M. F. required for charging the battery being obtained by means of a "booster," or supplementary dynamo. The field of the booster is separately excited from the bus bars of the existing plant, or from the terminals of the battery, the armature being connected in series with the main dynamo. With this method it is immaterial whether the main generator is a shunt or compound-wound machine.

The following letters designate the respective parts: A, ammeter; V, voltmeter; E, voltmeter switch; G, bus bar; L, lamps; B, booster; R, rheostat in field circuit of booster; F, field circuit switch; S, double-pole double-throw switch; O, overload switch; C, automatic cut-out; K, battery; H, reverse cell switch; D, leads to main generator.

Fig. 2 shows the method of connecting up, also the arrangement of the switchboard, for a storage battery plant, where the generator is a shunt-wound dynamo, capable of giving the E. M. F. required for charging the battery. The lamps can be run from battery alone, or from battery and dynamo working together in parallel. While the battery is being charged, the voltage on the lamps can be maintained at the normal pressure, independent of the higher E. M. F. required from the dynamo for charging the battery, by means of the reserve cell switches.

In this diagram A, represents the ammeters; V, voltmeter; E, voltmeter switch; G, bus bars; L, lamps; D, dynamo; R, rheostat in field circuit of dynamo; S, lamp switch; S¹, dynamo switch; O, overload switch; C, automatic cut-out; K, battery; H, reserve cell switches.

Fig. 3 shows one method of connecting up storage batteries on the 3-wire system. The two batteries are charged from dynamos capable of giving the required E. M. F., but both batteries and dynamos are always connected to the 3-wire system, the regulation of E. M. F. being effected by means of the reserve-cell switches. With this arrangement the batteries need never be cut off from the lighting circuits, and are always available as regulators, and in case of emergency. A current-recording meter is used to show the accumulated charge and discharge of the batteries.

In this arrangement A, represents the ammeters; V, voltmeters; E, voltmeter switches; L, lamps; N, neutral wire; D, dynamos; R, rheostat in field circuits of dynamos; S, battery switches; S¹, dynamo switches; S², lamp switches; C, automatic cut-outs; K, batteries; H, reserve-cell switches; W, current-recording meters.

While designated as a catalogue the publication is, in fact, a small treatise on the subject and will be found of value to all engaged in current utilization, of whatever kind. The catalogue can be had on application to the company, price, $1.

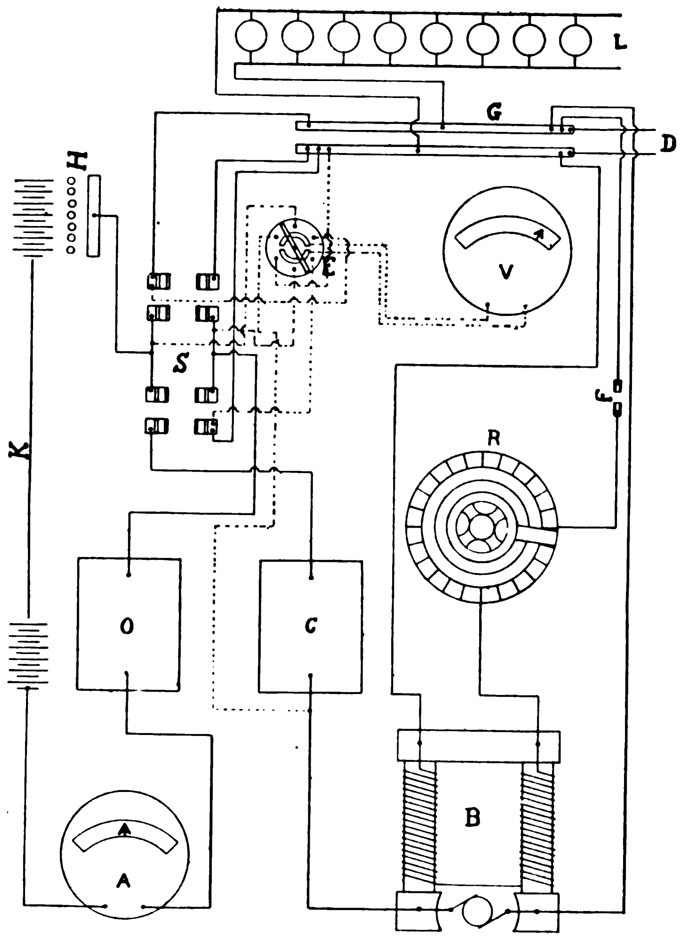


FIG. 1.

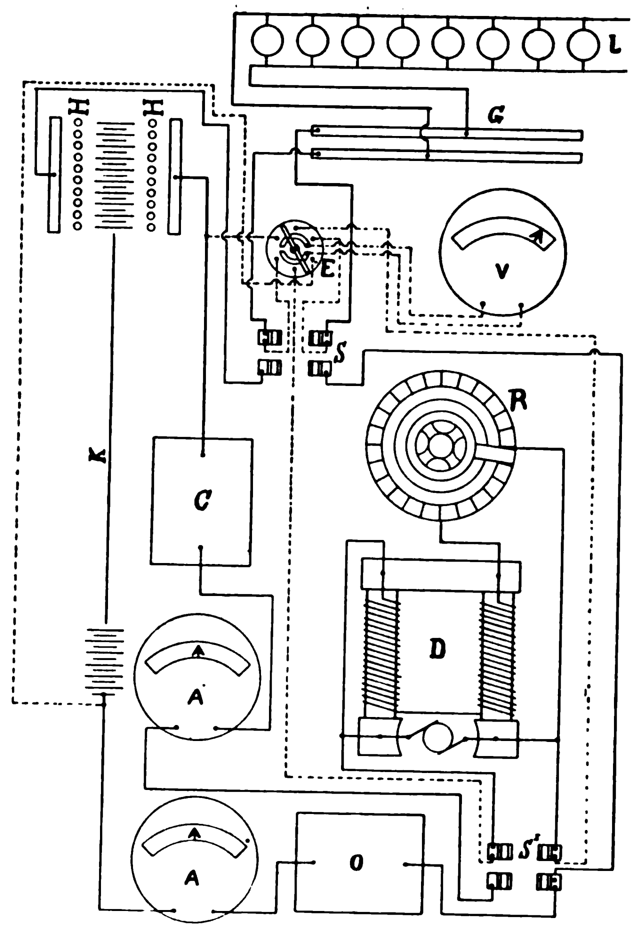


FIG. 2

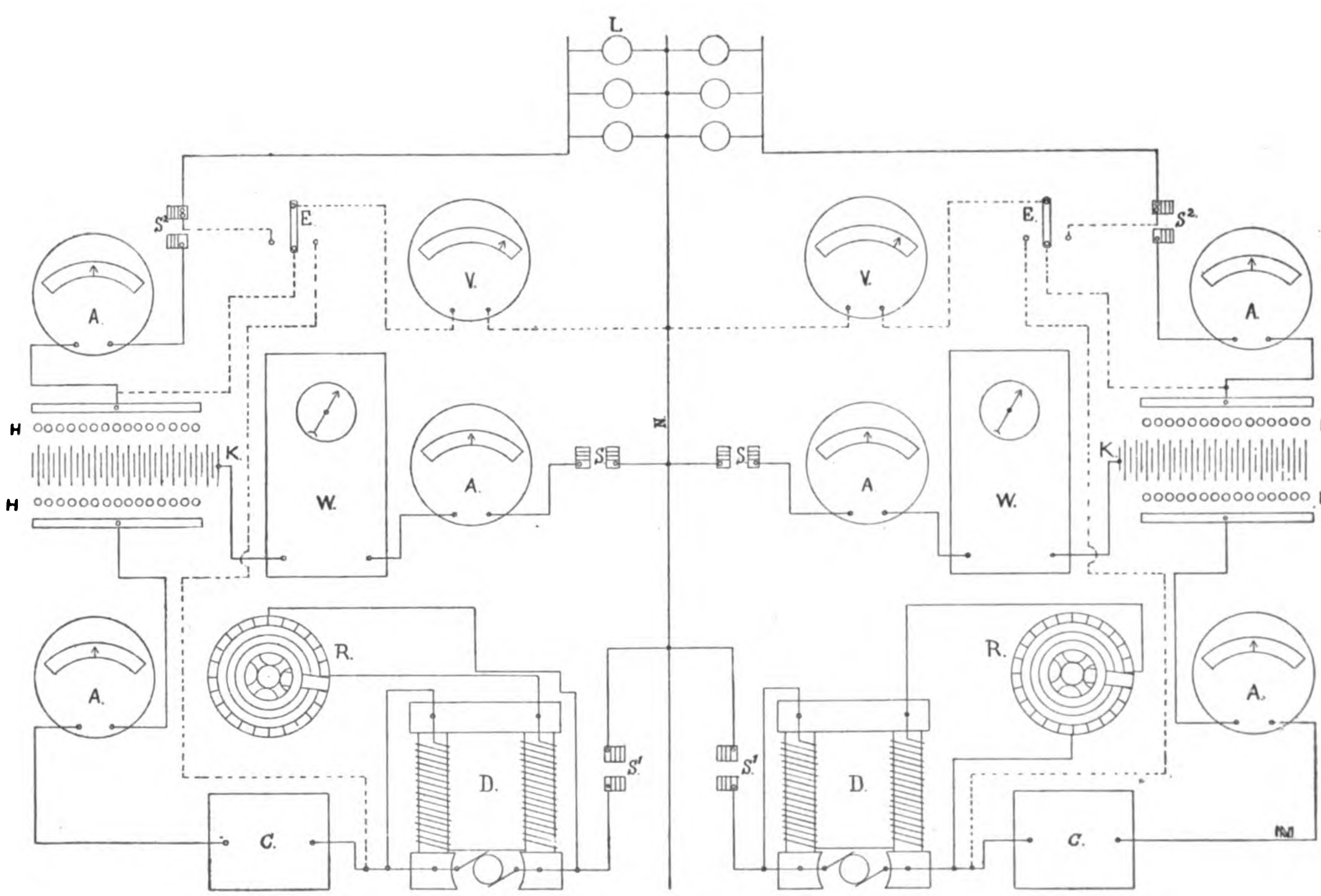


FIG. 3.

DIAGRAMS SHOWING VARIOUS METHODS OF CONNECTING STORAGE BATTERIES.

Society and Club Notes.

AN OHIO ASSOCIATION OF LIGHT & POWER COMPANIES.

The representatives of about 50 electric light and power companies met at Columbus O., on May 21, and organized a state association. Those present at the meeting were J. W. Swynn, Bucyrus; James C. DeLong, Lima; C. H. Juneman, Chillicothe; H. B. Hane, Marion; H. K. Wood, Piqua; J. P. Myers, Chillicothe; D. W. Mott, Lancaster; Miller Booth, Bellaire; J. H. Miller, Springfield; E. M. Poston, Nelsonville; J. Gwynn, Steubenville; B. P. Holmes, Youngstown; William C. Hedges, Mansfield; E. F. Gwynn, Delaware; Jerome Penn, Washington C. H.; William A. Lynch, Canton; A. F. Dickinson, Geneva; George L. Long, Bowling Green; L. C. Newson, Columbus; L. E. Thuller, Leetonia; E. H. McKnight. Middletown; Ira M. Miller, Akron; F. G. Warden, Newark; A. W. Field, Columbus; E. S. Trussell, Pomeroy; James C. DeLong, Toledo; Samuel Scovil, Cleveland.

There are about 80 electric light and power companies in Ohio and of these 50 will be members of the state association. The organization was perfected by the election of the following officers: President, A. W. Field, Columbus; vice-president, William C. Hedges, Mansfield; secretary-treasurer, Samuel Scovil, Cleveland; executive committee, George S. Long, of Troy, L. C. Newsom of Columbus, B. P. Holmes of Youngstown and H. K. Wood of Piqua; finance committee, E. S. Trussell of Pomeroy, Edward Gwynn of Delaware and T. H. Bostwick of East Liverpool.

The objects of the association are to promote the common interests of the members and to advance the scientific and practical knowledge of members in all matters relative to electric light and power; also to establish a cordial and beneficial relation with kindred associations and between the manufacturers of electrical machinery and appliances and the members of the association.

It is also understood the association desires to establish a uniform scale of prices and maintain relative rates for relative service among the customers in the cities of the state.

HENRY ELECTRICAL CLUB.

At a regular meeting of the Henry Electrical Club held at the rooms of the American Institute, of the city of New York, Tuesday evening, May 28, President W. H. Freedman in the Chair, the first business transacted was the nomination of officers for the ensuing year. The Committee on Nominations presented the names of the following gentlemen, who were duly elected: W. H. Freedman, E. E., president; L. H. Laudy, Ph. D., first vice-president; Max Osterberg, E. E., second vice-president; Geo. Whitefield, secretary.

The following resolutions were adopted, by the Club:

Resolved—That the members of the Henry Electrical Club sincerely regret the untimely death of the distinguished electrical engineer, Mr. George M. Phelps, who did so much to raise the standard of the electrical profession in this country; both as treasurer of the Institute of Electrical Engineers, and as editor and proprietor of The Electrical Engineer.

Resolved—That this resolution be spread on the minutes of this Club, and a copy sent to the Institute of Electrical Engineers and the Electrical Press.

Married.

Coles-Field.—Mr. Stephen Leidy Coles, associate editor of *The Electrical Review*, of Oew York, was married to Miss Sallie E. Field on June 1, and the happy pair are now receiving the congratulations of a host of friends. There is no more popular young journalist in electrical work to-day than Mr. Coles, who, besides, has a lively wit and sprightly pen that the comic and society papers are very glad to avail themselves of. His success in literary and married life will afford great pleasure to a large number of admirers of his steady and always excellent work.

THE NEW YORK CENTRAL BUYING CURRENT.

The New York Central Railroad established an isolated electric plant in the Albany station some years ago at a cost of $20,000. It has now come to the conclusion that an independent electric light plant for its own purposes does not pay; that the rates offered by the Albany Electric Illuminating Company are lower than the cost of manufacture. As a result of close figuring, the directors of the New York Central company recently decided to abandon the electric light plant here and take its electric power from the Albany company.

The Cable Insulator Co., has been organized at Saco, Me., for the purpose of dealing in electrical supplies of all kinds. The capital stock is $10,000. W. P. Sargent, of Boston, is president, and S. Oakman of Melrose is treasurer.

Letters to the Editor.

SERIES PARALLEL CONTROL OF RAILWAY MOTORS DATING BACK TO RICHMOND.

Referring to the editorial in your issue of May 15, on "Patenting Series Parallel Motor Control" in which you state that the Patent Office threw out the claims for the series parallel control because of "public use upon the Lehigh Avenue Railway in Philadelphia in the month of May, 1890," it might be well to point out that series parallel control was put into extensive use in Richmond in the beginning of 1888, and was afterwards discarded there because of the racing of one motor when on a heavy grade and a slippery track.

Frank J. Sprague.

New York, May 29, 1895.

SERIES-PARALLEL MOTOR CONTROL.

I am afraid the editorial in your issue of May 15, concerning the Hopkinson-Hunter interference on the series multiple method of controlling motors may be misunderstood and leave your readers under the impression that "the bars are down." My patent No. 500,066, covers broadly a switch for controlling motors by placing them in series or in parallel or dropping one of them from the circuit. Hopkinson never claimed this combination and the Hunter patent does not show it. It is in common use, and the patent is recognized as valid by the largest manufacturing companies.

J. C. Henry.

Pueblo, Col., May 21, 1895.

ELECTRO-THERMAL MOTORS.

Apropos of Mr. Irish's recent article on the employment of an electrically heated conductor to perform the operations now generally effected by means of electro-magnets, I would state that, as his patent attorney some years ago, I became acquainted with his inventions in this direction.

A special function of the heated conductor motor is slow and gradual action as opposed to the instantaneous attraction of the electro-magnet. This principle has its apparent applications. Aside from this, however, the action need not be slow. I have seen his devices operate very rapidly, due to the quick heating of the wire and therefore also rapid cooling due to the fact that the wire was very fine and exposed.

I have not made any measurements or calculations, but I feel confident from various experiments that the electro-magnet is more economical of current, but in many cases the matter of economy of current is a minor point. The thermal motor of Mr. Irish occupies comparatively little space, is enormously less in first cost, admits of slow action as well as quick, allows of no internal short circuits or insulation troubles, and produces no inductive effects upon opening the circuit.

Edward P. Thompson.

New York, May 17, 1895.

Legal Notes.

MUIRHEAD, ET. AL. VS. THE COMMERCIAL CABLE CO.

It will be remembered that suit was brought in England by Muirhead et. al. against the Commercial Cable Co., to recover royalties for the use of patents for duplexing submarine telegraph cables, which royalties they claim were due until 1897, by reason, as they maintained, of their 1880 United States patent being in force up to that time. The Commercial Cable Co. contended that the patent expired in 1891 by limitation with a prior similar patent taken out by the plaintiffs in Great Britain.

The lower court sustained the plaintiffs but the Court of Appeal reversed the decision in favor of the Commercial Cable Co. We now understand that the case will not be carried to the House of Lords, but that it has been compromised at the request of Messrs. Muirhead. The terms of the settlement are, we are informed, in favor of the Commercial Cable Co., which, would practically mean that the Company's grounds for defence were adequate and well taken.

THE BAXTER ELECTRIC MOTOR PLANT SOLD.

The plant of the Baxter Electric Motor Co., Baltimore, was sold on May 24 by Matthews & Kirkland, auctioneers, to B. F. Deford, Jesse Hilles and Michael Jenkins, representing the bond-holders of the corporation. The price paid was $25,000. The property includes a square of ground bounded by Chester street, Chase street, Collington avenue and Biddle street, and is improved by a two-story brick factory 320 feet long and 60 feet wide, and also a brick power-house, brick drying-house, a frame stable and all the patents of the corporation, together with the machinery, tools and finished product.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 28, 1895.

Accumulators:—

Secondary Battery, W. L. Silvey, Dayton, Ohio, 540,076. Filed Jan. 21, 1895.
Details relating to the insulation of the positive and negative plates. The plates are maintained in position by screw bolts passing through them; those of like polarity are welded to the through bolts by means of the electric arc.

Secondary Battery, C. Payen, Philadelphia, Pa., 540,185. Filed Aug. 17, 1893.
Consists of a conducting plate with ribs, and an independent plate of active material in contact with said ribs leaving spaces between the ribs.

Alarms and Signals:—

Annunciator, F. A. Jennings, Ithaca, N. Y., 539,870. Filed Mch. 23, 1893.
An improved combination advertising, train bulletin, train indicating and train annunciating board.

Electric Bell, C. B. Sterling, New York, 539,966. Filed Mch. 14, 1895.

Conductors, Conduits and Insulators:—

Electric Cable, W. D. Gharky, Philadelphia, Pa., 539,989. Filed Oct. 18, 1894.
Provides a cable with a high resistance test wire which is arranged in such a manner that any cause which would operate to produce a leakage of current from the main conductor or short circuit it, will first attack the test wire.

Distribution:

Stationary Transformer, W. S. Moody, Lynn, Mass., 539,876. Filed May 15, 1894.
Has for its object to provide a form of punching or lamina for the core of the transformer which shall permit of the ready circulation of the oil insulation.

System of Electrical Distribution, E. G. P. Oelschlaeger, Charlottenburg, Germany, 540,216. Filed April 6, 1895.
All the primary coils of the transformers are connected in series to form a part of the main feeding circuit, and the secondaries of each transformer are connected in parallel.

Dynamos and Motors:

Electric Motor, J. B. Atwater, Chicago, Ill., 539,849. Filed Sept. 24, 1894.
Consists mainly, of the combination of one or more cam-ring-tracks, and electrically operated traction levers adapted to be pressed against said tracks successively, at intervals, and thereby rotate the same.

Armature Coil and Method of Making Same, O. F. Persson and D. P. Thomson, Schenectady, N. Y., 539,881. Filed Oct. 6, 1894.
Consists in winding a coil having its two sides closely approximated and then drawing the sides away from each other, at the same time drawing the ends of the coil together, so as to form a six-sided figure, the two halves of which lie in different planes.

Armature Winding and Method of Making Same, W. Hochhausen, Brooklyn, N. Y., 539,943. Filed Feb. 10, 1888.
In a cylindrical armature, a set of armature coils, the wires of which are systematically disposed upon the head of the armature, and at such part are bent or offset in the direction of the armature axis so that each will partly underlie and partly overlie the wires which it crosses.

Brush Holder for Dynamo Electric Machines, E. Thomson, Boston, Mass., 540,085. Filed Feb. 20, 1893.
For description see THE ELECTRICAL ENGINEER, page 513, this issue.

Locating Faults in Electric Railways, J. C. Henry, Westfield, N. J., 540,054. Filed Jan. 24, 1894.
For description see THE ELECTRICAL ENGINEER, page 512, this issue.

Conduit Electric Railway, W. E. M. Jackson, San Francisco, Cal., 540,060. Filed Oct. 25, 1893.
Uses a long surface of the insulating medium, coiled, or otherwise bent, twisted or turned, one or more of such coils forming the support for the conductor.

Electro-Metallurgy:—

Electromagnetic Gold Separator, J. D. Gibbens & W. B. Murray, Portland, Ore., 539,804. Filed Oct. 20, 1894.
Consists of a stepped section or extension of the sluice-box covered with copper plates having lateral grooves therein for the reception of the mercury for amalgamating purposes, the said plates having placed thereon a series of adjustable electro-magnets having a broad flat armature or core extension.

Galvanic Batteries:—

Galvanic Battery, H. T. Johnson, New York, 539,871. Filed Nov. 10, 1893.
Details of construction relating to dry batteries.

Lamps and Appurtenances:—

Lantern for Bicycle Riders, W. K. L. Dickson, Orange, N. J., 539,799. Filed Aug. 4, 1894.
Combines a rheostat with the lamp.

Process of Producing Incandescing Bodies for Electric Lamps, K. O. E. Trobach, Pankow, Germany, 539,838. Filed April 18, 1894.
Consists in immersing the substance to be carbonized in an acid as citric acid which will give off carbon when subjected to dry distillation, in which acid is suspended finely divided carbon with which the substance to be carbonized becomes thoroughly permeated and then carbonizing said substance.

Controller for Electric Search Lights, E. F. G. H. Faure, J. McHaffie & S. H. Libby, Schenectady, N. Y., 539,863. Filed Jan. 29, 1895.
An improved form of controlling stand and devices for search lights.

Electric Arc Lamp, J. A. Mosher, Chicago, Ill., 539,877. Filed May 1, 1893.
Involves a shunt solenoid which is cut into circuit upon the establishment of the arc.

Measurement:—

Electric Meter, E. Thomson, Swampscott, Mass., 539,886. Filed Feb. 18, 1895.
An electric meter composed of stationary series and shunt coils, a movable armature or coil acted upon differentially by such series and shunt coils, a circuit-breaker in the shunt circuit controlled by the movement of said armature, a registering device, and a motor device controlled by the circuit-breaker and operating the registering device.

Miscellaneous:—

Coupling, T. J. Close, Philadelphia, Pa., 539,796. Filed July 10, 1894.
A coupling for rods for rodding conduits.

Controlling Mechanism for Locks, R. A. Palmer, Boston, Mass., 540,095. Filed Feb. 4, 1895.
Adapted to be applied to ordinary locks, for control at a distance.

Electric Heater, C. J. Reed, Philadelphia, Pa., 540,073. Filed June 5, 1894.
For description see THE ELECTRICAL ENGINEER, page 513, this issue.

Electric Passenger Register and Recorder, J. W. Ellis, Albany, N. Y., 540,090. Filed Jan. 12, 1895.
The number of passengers are registered by circuits controlled by step plates on entering and leaving the car.

Water Wheel Governor, A. Giesler, Dayton, Ohio, 540,094. Filed Aug. 13, 1894.
The combination of an electric and a centrifugal governor, so that either one or both may act, each without interfering with the other.

Apparatus for Determining Differences Between Phases of two Electric Alternating Currents, M. Von Dolivo Dobrowolsky, Berlin, Germany, 540,153. Filed Oct. 27, 1893.
Combines a coil or a set of coils for each current, the two coils being set at an angle to each other, and a metallic body rotatably arranged in the magnetic fields of said coils with a device for opposing a counterforce to the rotation of the metallic body, and means for indicating the amplitude of the latter.

Railways and Appliances:

Conduit Electric Railway System, F. Barrell, New York, 539,786. Filed July 19, 1894.
Details of construction.

Combined Trolley Head and Wheel, W. H. Dalbey, Indianapolis, Ind., 539,798. Filed Oct. 11, 1894.

Electrical Connection, P. Rieth, Chicago, Ill., 539,825 Filed Feb. 28, 1895.
A novel construction of rail bond.

Safety System for Railways, A. L. Ware, Cambridge, Mass., 539,840. Filed Oct. 15, 1894.
Improvement upon the invention described in Patent No. 520,520.

Trolley Breaker, W. G. Carey & A. A. Ball, Jr., Schenectady, N. Y., 539,854. Filed Nov. 15, 1894.
The metallic end pieces are so constructed as to put upon the breaker a transverse strain by the longitudinal pull of the trolley wire.

Rail Bond, F. E. Buxton, Worcester, Mass., 539,931 Filed Apl. 15, 1895.
An electric rail bond comprising a bond wire or rod having substantially cone-shaped heads upset at either end and two loose collars having conical bores of slightly smaller diameter than the diameter of said heads.

Conduit Electric Railway, F. B. Widmayer, New York, 540,010. Filed Aug 3, 1894.
The conductor is carried in an enclosed section and contact is made by the plow depressing a lever acting through a rod and stuffing box.

Means for Connecting Motors to Car Axles, S. H. Short, Cleveland, O., 540,029. Filed Oct. 19, 1893.
A method of motor suspension so as to avoid heavy hammer blow upon the axle, wheels and rail joints.

Closed Conduit System for Electric Railways, H. A. F. Petersen, Milwaukee, Wis., 540,187. Filed Mch. 26, 1894.
The conductors are enclosed with a cover which is removed during the passage of the car.

Switches and Cut-Outs:—

Ceiling Board, H. O. Stillwell & J. G. Broman, Chicago, Ill., 539,832. Filed July 10, 1894.
Details of construction.

Telephones and Apparatus:—

Telephone Central Station, G. D'Adhémar, Paris, France, 540,012. Filed June 20, 1894.
Details of construction involving switchboard apparatus.

Conductor Distributing Frame, T. Spencer, Cambridge, Mass., 540,117. Filed Jan. 24, 1895.
A cross connecting board for telephone exchanges.

Electrical Exchange, A. E. Keith, F. A. Lundquist, J. and C. J. Erickson, Chicago, Ill., 540,168. Filed Nov. 7, 1894.
Details relating to an automatic telephone exchange system.

REPORTS OF COMPANIES.

CONSOLIDATION OF LIGHTING INTERESTS IN BROOKLYN.

The Edison Electric Illuminating Company of Brooklyn has secured control of the Citizens' Electric Light Company. The Edison Company has a large, well-developed plant on Pearl Street, with various stations throughout the city, and the Citizens' Company's fine plant is on De Kalb Avenue, between Navy Street and Hudson Avenue. Since last January the Citizens' and the Edison Companies have been struggling to get the contract for lighting the streets of the city, and the Board of Aldermen has on two occasions prevented the Edison Company from getting the contract on technicalities.

NEW OFFICERS OF THE BRUSH ELECTRIC CO.

At the annual meeting of the Brush Company but one ticket was nominated, and practically the entire capital stock voted in its favor. The following gentlemen, constituting the directory, will serve during the ensuing year: W. H. Lawrence, Myron T. Herrick and James Parmalee, of Cleveland; Robert Treat Paine, second, of Boston; Carl G. Smedberg, of Boston, and Joseph P. Ord, of Albany. After the stockholders adjourned, the directory elected officers as follows: President, Robert Treat Paine; first vice-president, Joseph P. Ord; treasurer, Carl G. Smedberg; general manager, S. M. Hamill; secretary and purchasing agent, A. H. Hough; superintendent and electrician, Charles N. Black; assistant superintendent, Frank Sneider. Mr. Smedberg has been assistant treasurer for the General Electric Co. since its organization. Prior to that he was assistant treasurer of the Edison General Electric Co. He will live in Cleveland hereafter.

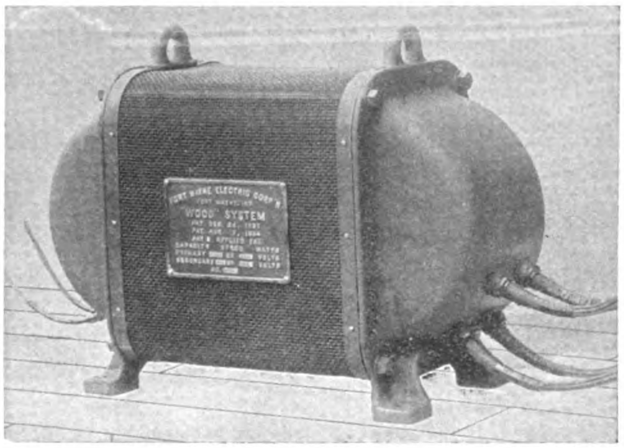
General Superintendent E. W. Rice, Jr., of the General Electric Co., was in the city looking over the Brush factory for the purpose of making a report of the condition of affairs to the General Company's office. The directors have decided, it is said, that the working capacity of the Brush can now be increased and in a measure restored to the condition of three years ago, before the panic compelled them to cut down the working force.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE FORT WAYNE ELECTRIC CORPORATION'S NEW 750 LIGHT TRANSFORMER.

THE accompanying illustration represents a new type 37½ K. W. transformer designed by Mr. James J. Wood for sub-station use. It is constructed so as to be used on either 1,000 or 2,000 volt primaries, of from 60 to 140 periods, and the secondaries are arranged for connection to either a two or three wire system. This transformer presents a very substantial appearance, while the design and construction is of the simplest, as well as the



NEW WOOD TRANSFORMER OF THE FORT WAYNE ELECTRIC CORPORATION.

neatest possible character. The ventilation is so perfect and the radiating surface so large in proportion to the output that the rise in temperature is very low, even when run for eleven hours on full load. The regulation is within 2¼ per cent., while the efficiency at full load is 98.33, ¾ load 98.39, ½ load 98.33, ¼ load 97.30, ⅛ load 95.09, $\frac{1}{16}$ load 90.82 per cent. This is claimed to be the highest efficiency ever obtained with an alternating current transformer. At present two sizes are ready for the market, 375 and 750 lights respectively.

THE JEFFREY MANUFACTURING COMPANY.

The Jeffrey Manufacturing Company, of Columbus, Ohio, who have an eastern branch at 163 Washington street, New York, have published a catalogue of their large variety of labor-saving and mining devices. The list is so comprehensive that only a small proportion of its contents can be mentioned here. An important part of the manufacture of the company involves various forms of elevators, single strand, double strand, centrally hung double strand, stone and ore, traction wheel, barrel and keg, tile and package elevators. A notable branch of the company's business is its coal handling machinery, for use with mechanical stokers, for power plants. In these plants the elevators, which are outside the building, raise the coal into the storage hoppers located inside the building, from which it is fed into the stokers. This is a typical example of the saving in labor which the appliances of the Jeffrey Mfg. Co. are designed specially to effect. The company make conveyors of every imaginable description, and no matter what the nature or size of the object or material to be transported, from one place to another may be, they are in a position to turn out machinery that will do the work. As is well known, the Jeffrey Co. has done a great deal of pioneer and successful work in the introduction of electricity into mining operations.

THE TRANSLUCENT FABRIC CO.

The Translucent Fabric Co., of 64 Federal St., Boston, Mass., are manufacturing a material, which not only professes to take the place of glass, but actually does so, and that, too, in a most effective and satisfactory manner. Indeed for many building purposes it possesses qualifications which make it preferable to glass. Translucent fabric is wire cloth covered with a translucent, impervious material. The wire cloth which forms the body of the fabric is made of steel, the meshes being small—12 to the inch. This gives great tensile strength, which is put down at 576 pounds to the square inch. The material which covers the wire cloth is a peculiar chemical solution, of great durability. It is not affected by heat, cold, rain, snow, hail or sleet. It is, in short, absolutely water and weather proof, perfectly flexible, will not crack or break, and is as translucent as skylight glass. It is not inflammable; heat will not affect it, and even the contact of a live coal will not ignite it. The weight of Translucent fabric is from one-seventh to one-tenth of glass, according to the thickness of the fabric. It is especially valuable for use in central station and power house skylights, roofs, windows, hothouses, or translucent partitions, for which purposes it is more economical than glass. In buildings where skylights or glass roofs are already in it would be a very easy matter to replace them with Translucent fabric, which can be bought in large sheets and stretched right over the framework and nailed down. It is practically impossible to make a skylight or glass roof that will remain watertight for a long period; leaks are constantly appearing, either from broken glass, openings between the frames and glass, or by the expansion or contraction of the glass. The translucent fabric saves all this trouble, and architects, builders and engineers are now showing the fullest appreciation of its excellence and adaptability.

THE COLOPHITE MANUFACTURING CO. OF NEW HAVEN, CONN.

The Colophite Manufacturing Co. of New Haven, Conn., have put on the market a new compound, "Colophite," which promises to be of valuable service in the arts and manufactures. Its constituents are carbon, hydrogen, and oxygen in variable proportions, according to its process of manufacture. Colophite, being a neutral substance, can be so prepared that it will unite with any known solvent. It is neither a gum nor a resin, but partakes of the nature of both. Its special value for electrical purposes, lies mainly in the fact that it forms a compound of excellent insulating qualities. In a recent comparative test, the best known insulators in use, at a voltage of 575, developed a resistance ranging from 1,600 megohms to 22,000 megohms, while Colophite insulation, at the same voltage, developed a resistance of 258,000 megohms.

When ground with earths, minerals of metallic oxides and mixed with a suitable solvent, Colophite will produce an enamel in any desired tint or color, superior to any now known for either wood, plaster, brick, stone or metals. When applied to any surface it flows readily from the brush, bears a good body, binds fast and firm, levels well, and withal has the prime advantage of drying quickly.

By varying the proportions of the ingredients, Colophite may be made to resemble stone, wood, ivory, horn, whalebone, leather or bone, and is susceptible of a very high polish. Colophite is a natural base for many compounds, from that of a light water-white solution, suitable for water-proofing fabrics or lacquering the finest paper or metallic surfaces up to a heavy wax-like mass, which may be flowed, dipped, brushed, cast, molded, pressed, turned, rolled, stamped or formed into any useful or ornamental article.

The Colophite defecation is used by architects, builders, etc., for preventing all plaster discolorations caused by organic matter or salts in the clay of brick or other building materials in the structure of houses or other buildings. It can be applied cold with a brush, and it is claimed that one coat of it has the virtue of three coats of paint. Among the colophite preparations are numerous acid-proof, water-proof, insulating and other enamels.

GREENE-WHEELOCK ENGINES FOR THE BOSTON EDISON CO.

THE EDISON ELECTRIC ILLUMINATING CO., of Boston has just awarded the contract for a new engine to the Wm. Cramp & Sons Ship and Engine Building Co., of Philadelphia. This engine will be of the Greene-Wheelock cross-compound type built on the Rockwood compound system and with the Hill valve gear.

The engine will have a maximum capacity of 1,600 H. P., with normal of 1,200 H. P., operating at 100 R. P. M. under 160 lbs. of steam pressure.

In accepting the contract for the engine the Cramp Company guaranteed a consumption of not exceeding 12½ pounds of water per horse power hour *after one year's running* of the engine, under a heavy forfeiture. The remarkably low rate of consumption guaranteed will make this plant one of considerable interest, more especially as the engine will be placed right alongside a number of triple expansion engines. The economy of 12½ pounds is said to be highest ever guaranteed in any electric light or power station in the United States. Mr. F. Sargent, of Chicago, is the consulting engineer.

THE MONOCYCLIC SYSTEM AT GALESBURG. ILL.

With regard to its "Monocyclic" system, the General Electric Co. has received the following letter:

In answer to yours of the 22nd inquiring as regards our monocyclic system, would say, they run nearer perfection than any dynamos and motors we have had in the past ten years. The current is on continually and the dynamos and motors both run cool and practically without attention. It is now two months since installing and there has not been a single fault.

GALESBURG GAS & ELECTRIC LIGHT CO.,
(Signed) J. K. MITCHELL, Sec'y.

SHIPMENTS OF BALL ENGINES.

Recent shipments made by the Ball Engine Co., Erie, Pa., are noted as follows:—

Library of Congress, Washington, D. C., three 175 H. P. engines direct connected to Mather Electric Co.'s dynamos; Rock Creek Railway Co., Washington, D. C., and Chevy Chase, Md., one 300 H. P. tandem compound engine with extended sub base and divided connecting head; Hahne & Co., Newark, N. J., one 125 H. P. engine; Baltimore City Jail, Baltimore, Md., one 35 H. P. engine; C. Jevne & Co., Store Building, Chicago, one 60 H. P. engine direct connected to Siemens-Halske dynamo; City of Wells, Minn., one 70 H. P. engine direct connected to General Electric Co. dynamos; Catholic University, Washington, D. C., two 50 H. P. engines; Tootle, Wheeler & Motter, store building, Saint Joseph, Mo., one 100 H. P. engine; Mount Washington Light & Power Co., Hollins, Md., one 100 H. P. engine; J. M. Warner, electric light plant, Oneida, N. Y., one 60 H. P. engine; Tarentum Passenger Railway Co., Tarentum, Pa., one 100 H. P. engine; Swofford Dry Goods Co., Kansas City, Mo., one 60 H. P. engine; Juvenile Female Offenders Home, Geneva, Ill., one 60 H. P. engine direct connected to C. & C. Electric Co. dynamo; C. E. Johnson & Co., Building, Chicago, one 40 H. P. engine direct connected to Western Electric Co. dynamo; J. F. Weissner & Sons, Brewery, Baltimore, Md., one 50 H. P. engine; Duquesne Electric Supply & Construction Co., Pittsburgh, Pa., one 35 H. P. engine; C. D. Kaier Brewing Co., Mahanoy City, Pa., one 60 H. P. engine; Chesapeake Light & Power Co., Hampton, Va., one 40 H. P. engine; Bucyrus Steam Shovel Co., Bucyrus, O., one 25 H. P. engine; City Bank Building, Buffalo, N. Y., one 60 H. P. engine; D. M. Rhea, Fulton, Ky., one 125 H. P. engine; Western Electric Co., Chicago, one 60 H. P. direct connected to Western Electric dynamo.

THE CHICAGO COLD SNAP.

The Central Electric Company says that although the frost seems to have caught the young grape vines and pingree potatoes, and the Hessian flies have chased wheat almost out of the pit, up to the present there are no flies on the Lundell Fan Motor, Hessian or otherwise; and while the atmosphere in the neighborhood of a Lundell is always more or less frosty, it does not reach an uncomfortable degree. Inquiries come pouring in just the same, and the prospects for a brilliant fan motor season are very promising. They also report a steadily increasing demand for interior conduit and kindred supplies. Architects and owners are rapidly learning the value and expediency of the perfect work made possible with Interior Conduit. A recent large order covered several thousand feet for an Illinois post office.

THE ELECTRIC BOILER COMPANY.

The Electric Boiler Company of 23 and 25 Stillson St., and 15, 17 and 19 Achilles St., Rochester, N. Y., whose officers are J. Henry Howe, president; Chas. S. Hopkins, M. E., vice-president and superintendent, and Wm. T. Bassett, secretary and treasurer, have issued a descriptive catalogue and price list of their "Electric" boiler for steam and hot water heating and for steam power. The excellencies of the boiler are well set forth and its superiority over methods of heating formerly in vogue is discussed. The advantage of steam heating over the open fireplace, with its dirt, cold draughts, and need of attention; over the stove, with its dust and dirt, its absorption of oxygen, and its exhalation of carbonic acid and carbonic oxide gases; and over the hot air furnace, which but too often fills the house with over-heated air (robbed of oxygen) and injurious gases,—is daily becoming more appreciated in this country. The company are prepared to contract for steam heating on any scale. Their boiler is made in over 300 different sizes.

C. W. HUNT COMPANY.

The C. W. Hunt Company, of 45 Broadway, New York, have published Catalogue No. 9503 of their industrial railways for manufacturing establishments. In its pages they have first anticipated the many questions by which a manufacturer who needs a railway for handling material is immediately confronted, and have then answered them. Among these are such queries as: What gauge is the best for this purpose? What radius curves should be used? How heavy should the rail be? What style of cars will be best? What kind of cross ties should be used? How shall the switches and crossings be made? Can turntables be avoided? What will be the effect of grades? etc., etc. The C. W. Hunt Company claim that their system of Industrial Railways answers all these questions, and gives without trouble, delay or expense the results arrived at by those who have for many years, devoted themselves to the subject, both as builders and users of this class of machinery. Their cars run around a curve as easily as on a straight track, and the ease of running, rapidity of operation, and safety from derailment are invariably appreciated by those who have had experience with the ordinary rigid wheel base cars. Among the specialties of the C. W. Hunt Company are their tip cars, charging, gas-coke, foundry, and dumping cars, and a long list of cars in which curious and ingenious adaptations to special and unusual requirements are made.

THE COMMERCIAL ELECTRIC COMPANY OF INDIANAPOLIS.

Exacting as are the requirements of modern electrical engineering, there is in the trade no lack of enterprising firms who are content with nothing less than the best products that skill and improved machinery can turn out. An illustration of this is found in a catalogue just published by the Commercial Electric Company, of Indianapolis, Ind., describing their new multipolar dynamos and motors for power, lighting and railway purposes. They are building these in many sizes, for both direct connection and belt driving, as illustrated recently in these pages. Their bi-polar type generators vary in capacity from 15 to 40 K. W. They have wrought iron fields, and are of such magnetic strength that the machine may be operated at all loads without shifting the brushes. They have every modern improvement. The company's power and railway generator is designed for those who are looking for a machine which will withstand the sudden variation and heavy temporary overloads incident to railway work without necessitating the constant attention which is required in many stations.

NEW YORK AGENCY OF THE COLUMBIA INCANDESCENT LAMP CO.

President J. H. Rhotehamel, of the Columbia Incandescent Lamp Co., has been in New York for the past week and has carried through very successfully arrangements for the further use of that Company's excellent products in the East. The New York headquarters at 1103 Havemeyer Building, have been placed in the hands of Mr. W. H. MacKay, who is well acquainted with the trade and with electric light consumers, and who is determined to beat the record of Columbia sales in this part of the world.

The Columbia Company has just issued a new and attractive catalogue, from the press of the Werner Co., of Akron, O. It has an embossed cover in gray and gold, with the figure of a youth shielding his eyes for the brilliant rays of a Columbia, while in the dim, sombre background are several lamps that are assumed to be "competitors." The type body of the catalogue is printed in red, black and gold, presenting a very rich and tasteful combination. There is a brief introduction in admirable spirit and temper and then the leading Columbia brands are set forth in all the blazonry of stylish print. The chief items are the standard 110 volt lamps, anchored railway lamps, double carbon lamps, double window lamps, decorative lamps, candelabra lamps, candle lamps, &c. There is also a page of the leading sockets that these lamps are made for, and a compendious lists of the lamps in their different candle powers and voltages.

WARD AND KNIGHT ARCS FOR SALE.

The receivers of the Electric Construction and Supply Co., of 14 Cortlandt street, this city, offer for sale, in our advertising columns, a choice lot of arc lamps of the Ward and Knight brands, as well as a lot of carbons of high quality, all for use on incandescent circuits. The offer is so attractive that it is hard to believe that central station men will let the chance slip. They won't have such opportunities again in a long time.

GENERAL INCANDESCENT ARC LIGHT CO.

Mr. R. B. Corey, sales agent for the above company, with headquarters at the Havemeyer Building, this city, sends us a handsome new catalogue of the Bergmann arc lamps for direct or alternating currents. It is a very large octavo, beautifully printed, and containing a large number of illustrations of rack rod lamps, plain or ornamental; twin lamps; "bijou" or chain lamps; alternating arc lamps; special arcs for photographic work; pole fixtures, ornamental brackets, hanger boards, etc. The lamps and details are set forth with great clearness and particularity; and the various merits are plainly and convincingly set forth. All who are using, or propose to introduce arc lamps on constant potential circuits, should secure a copy of this interesting and valuable catalogue.

MR. H. M. SHAW, manufacturer of the "Universal" non-arcing railway and central station lightning arrester, 126 Liberty street, reports that orders are coming in from all parts of the country for this specialty, in order to meet the summer bugbear of outdoor circuits. Mr. Shaw has been appointed manager of the Eureka Tempered Copper Co.'s New York office, at the same address, where he has a large and complete stock of commutators, segments, and brushes on hand.

THE BISSELL, DODGE & ERNER CO.

The above company have succeeded to the business of Bissell & Dodge, at Toledo, O., and will carry on the business at the same address, 518 Summit street. The business done by the company is that of wholesaling electrical supplies and acting as bulk electrical contractors. They also undertake the repairing of all kinds of electrical apparatus, with a thoroughly equipped shop, and are prepared to do good work quickly. They carry a full line of machinery and supplies, and report trade as brisk and improving.

The officers of the company are Frederick Bissell, president; John A. Erner, vice president; F. H. Dodge, treasurer, and G. G. Keip, secretary.

NEW YORK NOTES.

FISH, RICHARDSON & STORROW, the legal firm, of Boston, announce that they have opened an office at 80 Broadway and that Mr. Charles Neave has become a member of the firm.

THE ELECTRIC Co., 56 Broadway, report that orders are coming in from all parts of the country for their new Economic Regulating Socket recently described in THE ELECTRICAL ENGINEER.

THE TILLMAN PORTABLE ELECTRIC LIGHT AND REFLECTOR Co., of New York, has been formed by Harry A. Ockershausen, J. J. Lawley, T. A. Foy, J. McCarthy and Paul Brunel, with a capital stock of $100,000. The company will exploit among other things a new electric bicycle light.

THE BELL ELECTRIC Co. has been formed in New Jersey with a capital stock of $100,000 by F. M. Bell and others, to handle the Bell device for clipping or singeing off the hair of the head by means of a hot wire arrangement. The company controls this and other devices.

MR. A. A. CARY, the mechanical engineer of the Abendroth & Root Mfg. Co. has just returned home from a long and successful Western trip. He found indications of a revival of trade everywhere, while not less frequent were the friends of the Root boilers, now becoming so conspicuous in lighting plants and rail way power houses.

MR. C. P. SCOTT, formerly with the Sawyer-Man Co., has associated himself with Mr. Chas. I. Hills, in representing the Perkin, Electric Switch Co. in this city. Mr. Scott is one of the best known lamp salesmen in this section. With such a team the new Perkins lamp will have a remarkably strong representation in this part of the country.

WARREN & LOZIER, comprising Aldred K. Warren and R. T. E. Lozier have decided to dissolve partnership, the latter intending to devote himself to other work in the electric lighting and power field. Mr. Warren will continue the business of the young firm, which has been very successful. Mr. Lozier proposes before settling down to his new work to take a run over to Europe to size up the way they do things there.

NEW ENGLAND NOTES.

BERLIN IRON BRIDGE CO.—The Malleable Iron Fittings Co., of Branford, Conn., have placed the contract for their new foundry building with the Berlin Iron Bridge Co. The new refrigerating plant for the International Cooling Co., Atlantic City, N. J., will be designed and built throughout by the same concern.

WESTERN NOTES.

GEN. SUPT. MURREY of the Rocky Mountain Bell Telephone Company spent last week in Chicago.

MR. CARL KAMMEYER, will continue to represent THE ELECTRICAL ENGINEER until further notice.

MR. FRANK B. RAE, of Detroit, has been retained to engineer the construction of a municipal electric light plant for Mason.

MR. J. G. KAELBER, of the Western Electric C., has closed a contract at Lynchburg, Va., for an electric light plant to cost $46,996.

JUDGE STANLEY S. STOUT, counsel for the Western Telephone Construction Company, is on a trip to Boston and other eastern points to look over the telephone situation.

THE METROPOLITAN ELECTRIC COMPANY, Chicago have recently received some good orders for the Keystone instruments, for which they are the Western selling agents. They guarantee the round type switchboard instruments to be correct within 2% and the standard Keystone type within 1%. The Missouri Light & Power Company of St. Louis, Missouri, recently placed an order for 136 of these instruments after making a very severe test on all makes now on the market. This speaks well for the quality of the Keystone.

MGR. J. H. MASON of the Simplex Electrical Company of Boston spent several days in Chicago last week. He, as well as Mr. Hixson, their Chicago representative, reports business very much improved within the past sixty days.

THE CHICAGO CLIMATE with its ups and downs makes it somewhat difficult for the station manager to decide as to the advisability of advocating fan motors or electric heaters for his customers. The wise station man who ordered fans during the earlier summer months is sure to reap the benefit.

KERITE WIRES AND CABLES are now permanently located in their new home in the Marquette Building where Mr. S. F. B. Morse has offices fixed up in first class style. A miniature rubber tree growing in a handsome vase shows in a striking manner the origin or source of Kerite.

ONTARIO, CAL.—Mr. John E. Adamson, of San Antonio, informs us that the town of Ontario, Cal., is to have electric lights. The same company will also run the Euclid avenue street railway, changing it over from horses to electricity. General Electric apparatus is to be used.

MR. B. J. ARNOLD'S new headquarters are in the Marquette Building, Chicago, where he has admirable facilities for his growing business in the electric railway engineering field, and where he will be happy to receive calls or inquiries relative to professional service.

SACRAMENTO, CAL.—The new telephone company has filed articles of incorporation. The capital stock is $200,000, of which $12,000 has been subscribed. The directors are George M. Mott, W. E. Erber, Charles L. Severance, George B. Katzenstein, A. Heilbron, Fred Cox, A. A. Van Voorheis, M. J. Dillman, George W. Locke.

THE ELECTRIC APPLIANCE COMPANY is highly pleased with the results that are being secured from numerous tests of the Packard lamp, being made independently by lamp users themselves in different parts of the county. In several cases it was demonstrated that the Packard lamp would only have to burn a few hundred hours to make its increased efficiency pay for the entire first cost of the lamp.

THE NEW YORK & OHIO CO., of Warren, O., have issued a natty and interesting little brochure about incandescent lamps in general and Packard lamps in particular. It shows a number of curves and tells what a real high efficiency lamp is. It also includes the excellent label got up by the Packard Co. which enables a user to note when the lamp was made, when it was put up and when it burned out. These records if properly kept by consumers will teach them many lessons about good lamps.

FINANCIAL.

ELECTRICAL STOCKS AND BONDS.

The recent activity in the stock market, resulting in material advances, was restricted chiefly to railway securities. Pending further and definite news about the crops, a lull has supervened, and the bullish tendencies of Wall street are finding a vent in the "Industrials." Great briskness was shown in that department last week, and the various stocks were generally lifted several points. On Saturday, General Electric touched 35⅝, a price it has not seen for some time.

Western Union has been fairly steady around 92½, and American Bell is now quoted at 202. Commercial Cable is now 155 bid.

J. P. Morgan & Co. and F. S. Smithers & Co. have been receiving subscriptions for $1,986,000 first consolidated mortgage 5% 100 year gold bonds of the Edison Electric Illuminating Co. of New York, due July 1, 1995.

Interest is payable January and July at par, bearing interest from July 1, 1895, payable 10% upon allotment and balance as soon as bonds are ready, probably June 15. Subscription list closed June 1.

General Electric stock brisked up a little, last week, on the strength of a report that the Company had a contract for equipping the New York Elevated system. But the story was premature. Officers of the Manhattan Railway Company say that there is no foundation for the reports that electricity is to be applied immediately to the elevated. New Yorkers are still to enjoy the services of the two or three hundred active little volcanoes on wheels.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

Vol. XIX. JUNE 12, 1895. No. 371.

COAL CONSUMPTION IN AN EDISON STATION, TYPE OF 1890.

IN our issue of August 10, 1892, we described the new station of the Edison Electric Illuminating Co., of Boston, and spoke of the possibility of their feeding the old and comparatively uneconomical stations from it at times of light load by means of tie lines. This policy was begun in May, 1893, and besides proving a decided financial success, it has furnished some data as to the use of coal when the station is supplying the same maximum but very different average loads. The complete data are given by Mr. R. S. Hale in a paper recently read before the Boston Society of Civil Engineers, entitled "Approximate Analysis of the Use of Coal in an Edison Electric Station of the Type Standard about 1890." The station selected by the author consists of 10 non-condensing Armington & Sims engines 15"x15½", each belted to two No. 20 bipolar Edison 50 K. W. dynamos

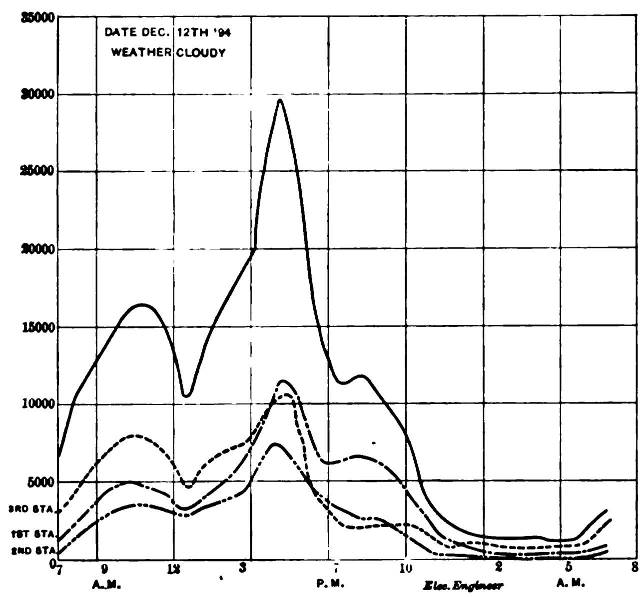


FIG. 1.

and supplied with steam at 100 lbs. gauge pressure from five boilers, Heine and Babcock & Wilcox, aggregating 12,390 sq. ft. of heating surface.

Comparing the monthly records of coal used and K. W. hours generated since January, 1893, it is found that whenever the station is completely ready to run, the coal used may be expressed by the relation: Coal used=500 lbs. per hour + 7½ lbs. per K. w. hour. Seven and one-half lbs. per K. w. hour, or, roughly, 5½ lbs. per electrical horse power hour is,—after allowing for the over and under loading of the engines and for the fact that the valves may not be absolutely tight,—not much worse than the figures obtained on this class of engines on test runs, and with this quality of coal. The constant loss of 500 lbs. per hour is divided into: Hot chimney gases, radiation from boilers, radiation from steam pipes, and steam leaks. The two latter, or steam pipe losses, were measured directly and found to amount to 300 and 600 lbs. steam per hour, or about 33 and 67 lbs. coal, respectively. The first two were measured together by shutting the stop valve of a boiler and finding how much coal it took to keep up the pressure

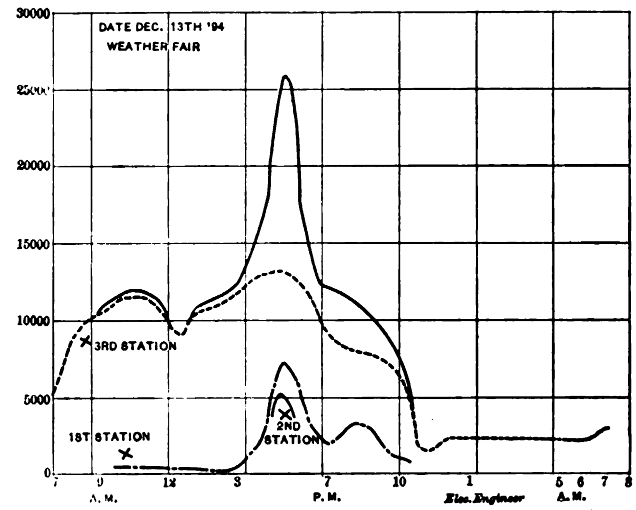


FIG. 2.

without making any steam, and this was found to nearly account for the remaining 400 lbs. of constant loss. This gave as the coal consumption:

33 lbs. coal per hour radiation from steam pipes.
67 " " " steam leaks.
400 " " " hot gases and radiation from boilers.
500 " " " constant loss independent of load.
7½ lbs. per K. W. hour for all power produced.

In an appendix the author has given data from a similar

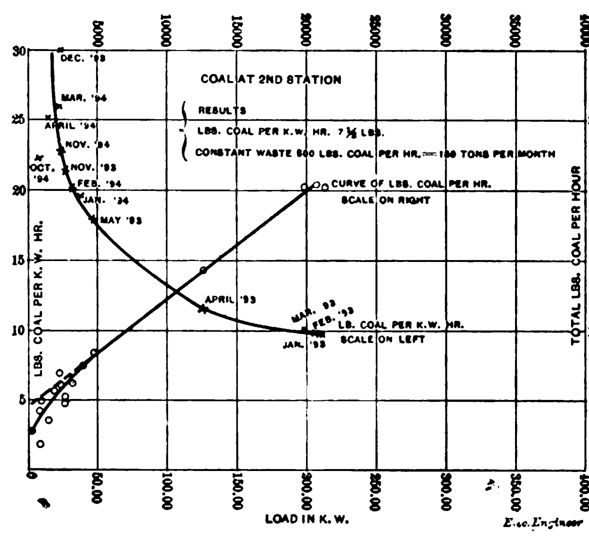


FIG. 3.

Edison station where, on assuming the loss constant and comparing the Sunday and weekday figures, the loss was found to be about 1,750 lbs. per hour for a station about

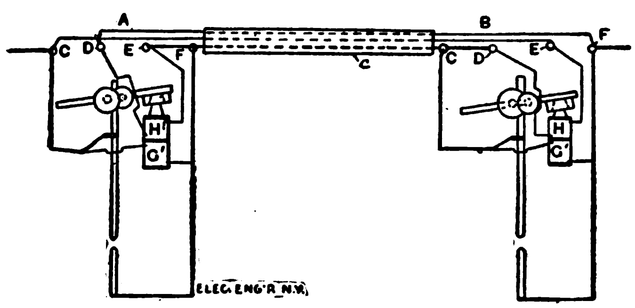
three times the size of that in Boston, and the net rate about 6.8 lbs. per K. W. hour, with higher steam pressure and some compound engines.

We add from the paper three curves. The first is an ordinary load diagram of the Boston system and of each of its three districts. The second gives the load generated at the different stations and the total, showing the effect of the tie lines in throwing the load to the economical station. The third gives the relation between the average K. W. and the pounds of coal per hour and per K. W. hour from which the equation which is the subject of the paper is deduced. The paper expressly disclaims being anything more than an approximation, but is of the greater value since its results are those of actual commercial running.

THE RUSHMORE ARC LAMP FOR CONSTANT POTENTIAL CIRCUITS.

Although in the last few years there have been great improvements in arc lamps adapted to burn in series on the usual incandescent circuits so that in many cases the older constant current system has been entirely supplanted, the general adoption of the incandescent arc lamp is due entirely to the greater economy and applicability of the constant potential over the constant current system and not to any superiority of the lamps, per se.

Aside from the question of the relative economy of the two systems, as regards the generation and distribution of the current, the present incandescent arc lamp is a much



The Rushmore Arc Lamp for constant Potential Circuits.

less economical or satisfactory apparatus than the high tension series lamp, for the reason that a good high tension lamp will give a satisfactory light with the cheapest grade of carbons and will run for very long periods without losing its adjustment while its constant potential rival will usually burn only the finest imported carbons with the nicest adjustments and with arcs so short that in many cases almost as much current is wasted in the resistances as is used in the light.

After a number of attempts to use the cheaper domestic carbons with incandescent arc lamps and to run with the arcs of the same length as in the high tension system, Mr. S. W. Rushmore, of Jersey City, N. J., concluded that as the two lamps in series must not only keep the volume of current constant but equally divide between them the voltage remaining after passing the rheostat, whether the line voltage be high or low, there must be some interconnection between the lamps, whereby the action of one lamp should be dependent on that of the other, and to that end he devised the system described below.

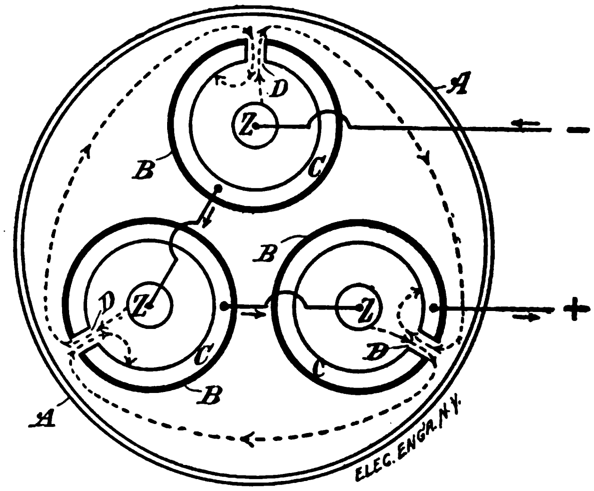
In the diagram, A and B represent two lamps of the usual shunt magnet type connected in series with a resistance in the usual manner. G is the usual shunt coil connected across the terminals of the lamp and upon this shunt coil there is wound an additional fine wire coil adapted to act in opposition to the first or main coil and connected to the additional binding posts D and E; these extra terminals in each lamp being connected to the main terminals of the other lamp in the series, and as the main wire may be used as a common return, this connection is effected by means of a cable consisting of the usual main wire and two smaller wires, as shown.

It will thus be seen that we have two lamps in series, the feeding of each being controlled by a magnet in shunt with its own arc and opposed by a coil in shunt to the other arc. The effect of this arrangement is to make each lamp dependent upon the other and to entirely prevent "see sawing" and jumping even with very long arcs and consequently with ordinary carbons. This improvement has been applied to several types of lamps with the result that two lamps can be burnt in series on 110 volts using ordinary American carbons and with 45 volt arcs in direct competition with the high tension constant current system.

THE THEORY OF THE BOYNTON MULTIVOLT BATTERY.

BY J. OLIVER JOHONNOT.

Noticing several articles lately in The Electrical Engineer on the Boynton "Multivolt" Battery, and believing that an explanation of the reason why it *does* work without wasteful local action would be of interest to your



Action of the Boynton Multivolt Battery.

readers, I submit the following theory based upon the *actual* construction of the battery.

The accompanying diagram represents a horizontal cross section of the three pairs of zinc-carbon elements ZC, ZC, ZC, which are connected in series and immersed in a common exciting liquid held in a single containing cell A. The carbon cups C are pierced on one side with holes D to promote the circulation of the exciting fluid, thus ensuring its constant homogeneity, as well as affording an opportunity for the delivery of heat generated in the liquid to the walls of the containing jar, where it can be quickly dissipated by radiation. The carbon cups C are covered on the outside with an insulating coating B, which serves to prevent any local or short circuiting action from the zinc of one couple to the *outside* surface of the carbon of another.

It will now be seen that the only paths left open for the passage of short circuiting currents are *through* the openings D from the zinc of one couple to the *inside* surface of the carbon cup of another. Were it possible for such currents to flow they would take the directions indicated by the dotted lines of the diagram. An inspection of these lines of assumed local action shows that they would pass through the openings of the carbon cups in opposite directions, and, as their electro-motive forces would necessarily be equal, it is impossible for such action to take place.

AN INTERESTING FRANKLIN DOCUMENT.

BY

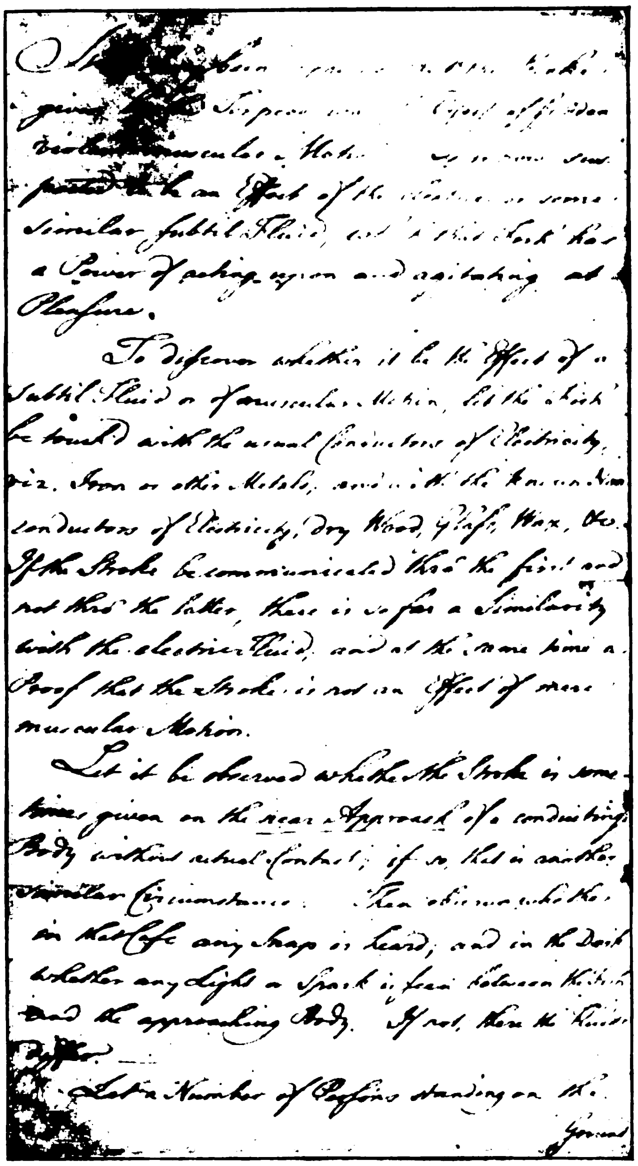
H. M. Stine

The illustrations accompanying this are a photographic reproduction of an autograph letter written by Benjamin Franklin to an eminent English scientist. The letter was preserved as an heirloom in the family, until 1892, when it came into possession of the Electrical Department of Armour Institute.

It was written during Franklin's second mission to England, as the agent of the House of Representatives of Massachusetts Bay. Owing to some untoward diplomatic jealousies, Franklin was engaged at this time in a bitter controversy with the then Secretary of State for the Colonies, Lord Hillsborough, whom he succeeded in defeating and deposing from his position in August, 1772. It is certainly a remarkable exhibition of the diversified abilities possessed by Franklin, that he could put himself in the proper scientific frame of mind to write such a letter in the midst of great political turmoil.

The scientific work upon which Franklin was at this time engaged was in connection with the protection from lightning of the powder magazines at Purfleet. As a member of a committee of four he drew up a report on this subject which was presented to the President and Council of the Royal Society on August 21, 1772.[1] Following this report on August 27, 1772, he read a paper on six experiments, entitled, "Observations and Facts Relative to the Utility of Long Pointed Rods for Securing Buildings from Damage by Strokes of Lightning."

On the back of the folded letter he had written :—

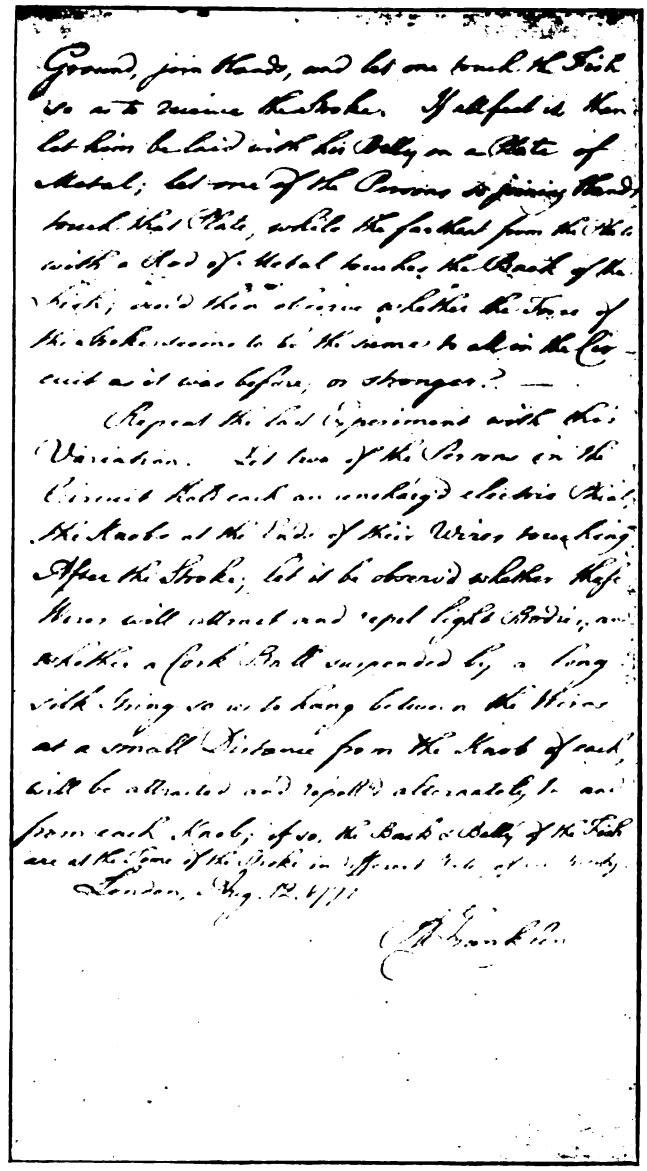


[illegible] Torpedo [illegible] Effect of sudden violent muscular Motion. [illegible] Effect of the Electric or some similar subtil Fluid, and that Fish has a Power of acting upon and agitating at Pleasure.

To discover whether it be the Effect of a subtil Fluid or of muscular Motion, let the Fish be touch'd with the usual Conductors of Electricity, viz. Iron or other Metals; and with the known Non-conductors of Electricity, dry Wood, Glass, Wax, &c. If the Stroke be communicated thro' the first and not thro' the latter, there is so far a Similarity with the electric Fluid, and at the same time a Proof that the Stroke is not an Effect of mere muscular Motion.

Let it be observed whether the Stroke is sometimes given on the near Approach of a conducting Body without actual Contact; if so, that is another similar Circumstance. Then observe whether in that Case any Snap is heard, and in the Dark whether any Light or Spark is seen between the Fish and the approaching Body. If not, then the Fluid differs —

Let a Number of Persons standing on the Ground



Ground, join Hands, and let one touch the Fish so as to receive the Stroke. If all feel it, then let him be laid with his Belly on a Plate of Metal; let one of the Persons so joining Hands touch that Plate, while the farthest from the Plate with a Rod of Metal touches the Back of the Fish; and then observe whether the Force of the Stroke seems to be the same to all in the Circuit as it was before, or stronger? —

Repeat the last Experiment with this Variation. Let two of the Persons in the Circuit hold each an uncharg'd electric Vial, the Knobs at the Ends of their Wires touching. After the Stroke, let it be observed whether those Wires will attract and repel light Bodies, and whether a Cork Ball suspended by a long silk String so as to hang between the Wires at a small Distance from the Knob of each, will be attracted and repell'd alternately to and from each Knob; if so, the Back & Belly of the Fish are at the Time of the Stroke in different States of [illegible]

London, Aug. 12. [illegible]

B Franklin

FAC-SIMILE OF FRANKLIN'S LETTER ON PROPOSED EXPERIMENTS WITH TORPEDO FISH.

"Franklin's Instructions to try if the Stroke of the Torpedo be Electrical."

The Letter.

It has long been supposed that the Stroke given by the Torpedo was the Effect of sudden violent muscular Motion. It is now suspected to be an Effect of the Electric or some similar subtil Fluid which that Fish has the Power of acting upon and agitating at Pleasure.

To discover whether it be the Effect of a subtil Fluid, or of muscular Motion, let the Fish be touch'd with the usual Conductors of Electricity, viz:—Iron, or other Metals; and with the known Non-Conductors, dry Wood, Glass, Wax, etc. If the Stroke be communicated thro' the First and not the Latter, there is so far a Similarity with the electric Fluids, and at the same Time a Proof that the Stroke is not an Effect of mere muscular Motion.

Let it be observed whether the Stroke is sometimes given on

1. Franklin's Memoirs, Vol. VI., p. 197 and p. 208.

the *near Approach* of a conducting Body without actual Contact; if so, that is another similar Circumstance.—Then observe whether in that case any Snap is heard; and in the Dark any Light or Spark is seen between the Fish and the approaching Body. If not, there the Fluids differ.

Let a Number of Persons stand on the Ground, join Hands, and let One touch the Fish, so as to receive the Stroke. If all feel it, then let him be laid with his Belly on the Plate of the Metal; let one of the Persons so joining Hands touch that Plate, while the farthest from the Plate with a Rod of Metal touch the Back of the Fish; and then observe whether the Force of the Stroke seems to be the same to all in Circuit as it was before, or stronger.

Repeat the last Experiment with this Variation. Let two of the Persons in the Circuit hold each an uncharged electric Phial, the Knobs at the Ends of their Wires touching. After the Stroke, let it be observed whether those Wires will attract or repel like Bodies, and whether a cork Ball suspended by a long silk String, so as to hang between the Wires at a small Distance from the Knobs of each will be attracted and repelled, alternating to and from each Knob; if so, the Back and Belly of the Fish are at the Time of the Stroke in *different States* of Electricity.

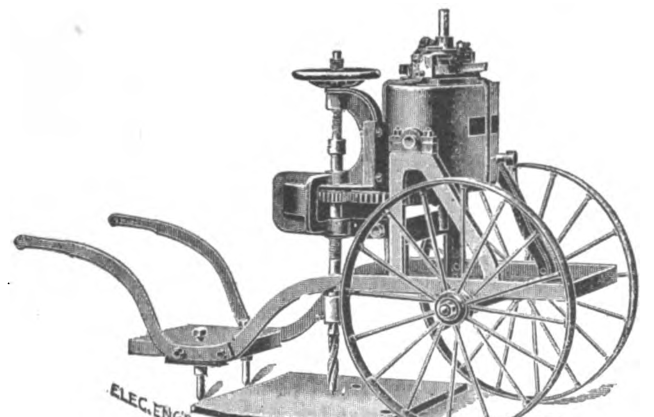
B. FRANKLIN.

LONDON, Aug. 12, 1772.

THE KODOLITSCH PORTABLE ELECTRIC MACHINE DRILL.

We illustrate on this page a neatly arranged portable electric drilling machine recently patented by Mr. F. Kodolitsch, managing director of the Austrian Lloyd's Steam Navigation Company's arsenal. It is claimed that Mr. Kodolitsch's machine can be adapted to almost any job, however difficult or inaccessible, and the inventor has developed a large number of different types which are employed in the arsenal of the Austrian Lloyd's Steam Navigation Company. Here, where the workmen are 2,000 in number, only an exceptionally small number of holes are now bored with the ratchet brace. A net of electric wires extends all over the place, and each shop is provided with a number of special drilling machines and the necessary cables so that any man who requires to bore holes has only to wheel the small portable drill to the work, and complete the operation at his bench, and thus saves much time.

The machine illustrated is intended for boring holes in the deck of a steamer to receive the screws holding the planking in place. As will be seen from the engraving, for which we are indebted to *Engineering*, the machine is mounted on a carriage, and can thus be easily moved from place to place. The motor is slung on trunnions, and drives the drill spindle by means of gearing. The spindle is fed forward by means of the handwheel shown. It is stated that with this device a man and a boy can bore four hundred ½-in. holes in ½-in. deck-plates per day.



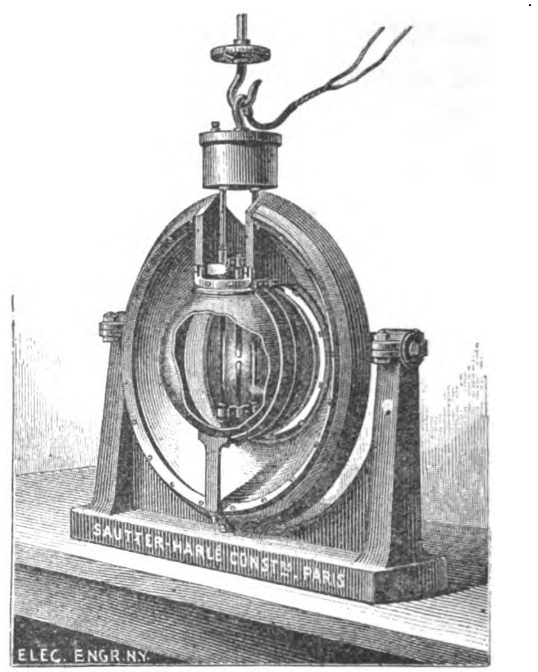
THE KODOLITSCH PORTABLE ELECTRIC DRILL.

When used for countersinking, the work done is from 800 to 1,000 holes per day. For this latter operation, the feed is not touched at all. The workman simply lifts the countersinking bit out of one hole by elevating the handles, wheels it to the next, and dropping it in keeps it there till the operation is completed.

Another drill does the somewhat awkward job of drilling the rivet-holes for a furnace mouth. In this instance the machine is wheeled up to the front of the boiler, and connected to a special drilling-bar by a flexible shaft. In the fitting-shop of the arsenal the machines have been largely used. Thus a large condenser may have all holes bored on one side whilst it is being planed on the other. A condenser for a 5,000 indicated horse-power marine engine has thus been finished complete without removing it from the table of the planing machine; even the seats for the air pumps were completely finished by a boring bar driven by one of the portable electric machines. Where necessary these latter can be slung by means of tackle, thus enabling work to be done in almost any position. In the shipyard the machines have proved extremely useful, not only for drilling and countersinking all rivet-holes, but also for cutting out side-lights, scuttles, and hawse-pipe holes. The sternpost bushes may also be bored out in a similar manner. In repairing stranded ships the machines have proved very convenient for drilling out the rivets of the plates to be replaced.

THE BLONDEL LUMEN-METER.

AT the Meeting of the Société Internationale des Electriciens, in Paris on May 1, Mr. Rey brought before the Société the new Lumen-Meter of M. Blondel. The apparatus is designed to permit of the direct determination of the mean spherical intensity of a source of light. The apparatus, which is shown in the accompanying engraving, consists of a sphere carefully blackened, and



THE BLONDEL LUMEN-METER.

having one or more openings in the shape of spherical segments. The flux of light which passes out by one of these openings is a determined part of the total flux. If the source of light spreads this symmetrically upon the axis of the segments it suffices to measure the flux which passes through the opening, and multiply it by $\frac{\alpha}{2\pi}$ in order to obtain the value of the total flux Φ.

In consequence the mean spherical intensity is $I_m = \frac{\varphi}{4\pi}$.

α, being the solid angle subtended by the segments. After passing through the segments the light is concentrated by a projector, which surrounds the sphere, and throws it on a diffusing screen of opal glass, from which it is sent to the photometer.

AN ELECTRIC LIGHT AND PUMPING PLANT AT DE KALB, ILL.

A pumping plant has been installed at DeKalb, Ill., in which water is pumped by a deep-well pump from a 10 inch drilled well driven by a 25 h. p. motor. The water from this pump discharges into a reservoir near the pumping station and it is pumped from this into the mains by two pumps, operated by motors. The pumps are of the triplex pattern, having three pistons 10 inches in diameter, with 12 inch stroke and are directly connected to a 50 h. p. multipolar slowspeed motor. The capacity of each pump is 500 gallons at 48 strokes per minute. For the domestic service the pumps work against a pressure of 60 pounds but being designed for fire service, are capable of working against a pressure of 125 pounds. An automatic device for closing the stand-pipe connections from the mains is used in case of fire. The current to operate the motors is furnished by the DeKalb Electric Company, a distance of 700 yards. In the contract between the town and the DeKalb Electric Company, the latter assume all care and attention of the machinery at a price of four cents per 1,000 gallons pumped.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE PARKER CONDUIT RAILWAY SYSTEM.

The accompanying engravings illustrate a conduit railway system designed for city streets, by Mr. J. E. Parker, of this city. As shown in Fig. 1, the conduit consists of a box-like structure built up in 10-foot sections and resting on a broad flange. The conductor D rests in a slot on the top of the insulator E, which is petticoat-shaped and closely resembles in pattern the ordinary telegraph insulator. In order to prevent the accumulation of dirt the top of the conductor is bevelled, and projects about an inch above the insulator. A space of 8 inches is left between the bottom of the conduit and the bottom of the insulator, so that there is little danger of accumulations reaching to the conductor and so causing leakage or short circuiting of the current.

A special trolley guard and guide has been provided, as illustrated in Fig. 2. This consists of two bars of metal, FF, wide enough to ride easily in the road slot, connected together by a flat frame of metal, G, having a slot in the centre, in which is placed a wheel I, which also runs in the roadway slot. The trolley guard performs three important functions: the bars, FF, clear away all obstructions from the slot; the frame G protects the trolley shaft from injury against the sides of the slot, and the wheel I, which is expansible, and presses against the sides of the slot, forms, in connection with FF and G, the earth, or return circuit. The wheel I is made of hard steel, so that it may not easily wear away, and the continual passing of the cars keeps the sides of the slot in good condition for making a good electrical contact.

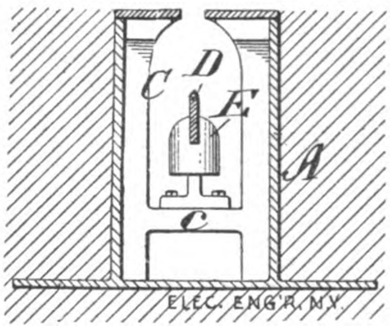


FIG. 1.—PARKER CONDUIT RAILWAY SYSTEM.

The shaft from which the trolley arm H is hung is made of vulcanite or other suitable non-conductor. Its peculiar formation at the end insulates it, and a simple mechanical device enables the motorman to reverse the position of the trolley so that the car can run in an opposite direction. The trolley shaft passes through the slot in the trolley guard G and, as the slot in the trolley guard is of less width than the roadway slot, and is placed fairly in the centre of FF, the trolley cannot touch the side of the roadway slot; even in going round a curve the trolley is kept fairly in the centre of the slot, and it is also placed out of the reach of injury by heat caused by friction. The end of the trolley nearest the conductor is hollow or horn-shaped, which insulates the trolley wheel and effectually prevents any escape of the current. Fig. 1 is a cross-sectional view of the trolley. A flanged wheel at the end of the trolley rides on the top of the conductor, and the trolley is kept in its place by a strong spring pressing it on the conductor.

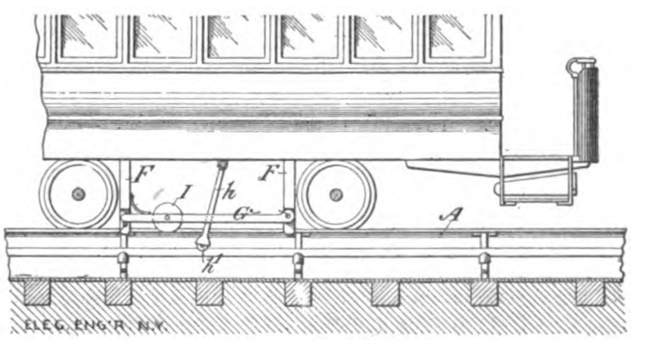


FIG. 2.—PARKER CONDUIT RAILWAY SYSTEM.

It will be seen that in consequence of the direct contact of the trench all along its length and of the whole of the metal work with the earth, that not only is the contact for the return made with the greatest certainty, but any possible derangement of the conductor would be quite harmless both to person and property, because the conductor in that case would certainly touch some part of the metalwork of the conduit and make earth, thus preventing any effects of the derangement being felt even at a distance of one inch from the spot where the contact takes place.

A LONG ELECTRIC ROAD FOR CALIFORNIA.

R. S. Dickson, of Placer County, Cal., states that the work of constructing the Marysville and Auburn Electric Railway has been commenced. It will cover nearly fifty miles of track. The purpose is to afford the orchardists and farmers in the foothills easier facilities for getting their produce to market at lower cost. Passengers will be carried, as well as freight. It was the first intention to have this line run from Marysville to Nevada City, but by that route the freight would have to be handled twice. By the route adopted it will be placed directly on the Central Pacific trains at Auburn and sent East at lower rates. This electric road will tap one of the most productive parts of the State, where everything from an orange to a pumpkin grows, and in abundance.

The power for the electric road will be furnished by the South Yuba Water Company, whose supply is inexhaustible.

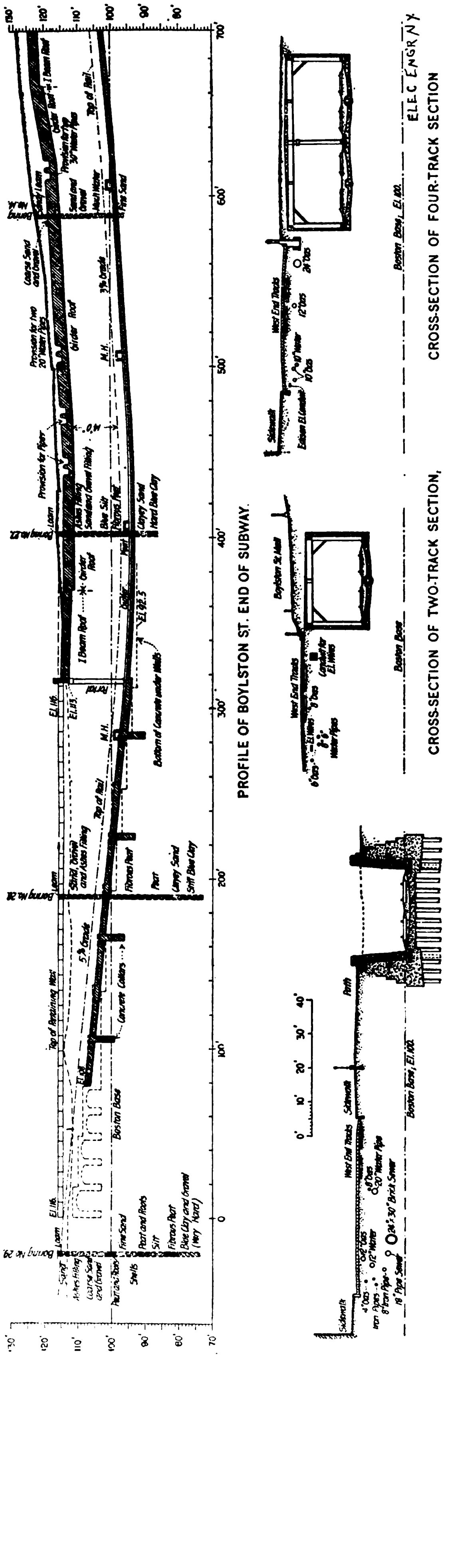
The power plant will be situated near the line of the road below Grass Valley, where the water company's canal will be given a fall of from 70 to 90 feet. After the water is used for the power plant it will be taken up again in canals and carried on for many miles for irrigating the lower lands.

The South Yuba Water Company is fitting up a 1000-horse-power plant at Newcastle, Placer County, for lighting purposes. It will furnish electric light for New Castle, Penryn, Loomis, Rocklin, Roseville and Antelope, and the surplus electricity will be carried into Sacramento. Not only will electric light and power be furnished to the towns stated, but every farmhouse and the public roads along and contiguous to the line will be lighted from the same source. The officers of the Company state that as soon as Sacramento demands more electricity, they will put in additional plants and give any quantity desired. Along their irrigation canal they have made twelve or fifteen "drops," varying from 40 to 150 feet, where electric plants can be established at but little cost. Several small plants have been placed at these drops, where manufactories have been or will be established.

MR. PAYNE ON THE MILWAUKEE STREET RAILWAY SITUATION.

Speaking of the embarrassments of the Milwaukee street railway system, Mr. Henry C. Payne, its receiver, said a few days ago:—"It is now about five years since I commenced the work of consolidating and equipping with electricity the several lines of railroad in Milwaukee, the construction of the Edison Electric Illuminating Company plant, and the extension of the arc-lighting system operated under the name of the Badger Illuminating Company. We have gone forward during all these years to the completion of our enterprise, perfecting the railway system, extending and unifying lines of railroad so as to best accommodate the people. In view of later developments it is evident that we were oversanguine as to the results to be obtained from the introduction of electricity as a motive power, and that the amount of money we invested in the purchase of the several properties since consolidated into the Milwaukee Street Railway was largely in excess of what experience has shown we were justified in paying. While the increase in receipts by reason of the introduction of electricity has been considerable, it has not been in proportion to the increased cost of operation and maintenance of the electric lines and the life of the electric appliances, motors, etc., about which little was known when the electric system was introduced, has proven to be much shorter than was anticipated. The burden of this depreciation has proved a serious and almost disastrous factor. Much has been said regarding the large bonded indebtedness of the company, but in point of fact the bonds issued upon the property represent nothing beyond its cost to the present owners, nor have the present owners received out of the earnings, either in dividends upon their stock or interest upon their bonds, one single penny of return on their ownership or operation of the property down to the present time."

The Milwaukee Street Railway Company operates 135 miles of road in Milwaukee by electricity, and has a practical monopoly of the street railway business of that city.


PROFILE OF BOYLSTON ST. END OF SUBWAY.
CROSS-SECTION OF TWO-TRACK SECTION, CROSS-SECTION OF FOUR-TRACK SECTION
CROSS-SECTION OF OPEN INCLINE APPROACH

FIGS. 2, 3 AND 4.—PROFILE AND CROSS SECTIONS OF BOSTON ELECTRIC SUBWAY.

THE BOSTON ELECTRIC RAILWAY SUBWAY.

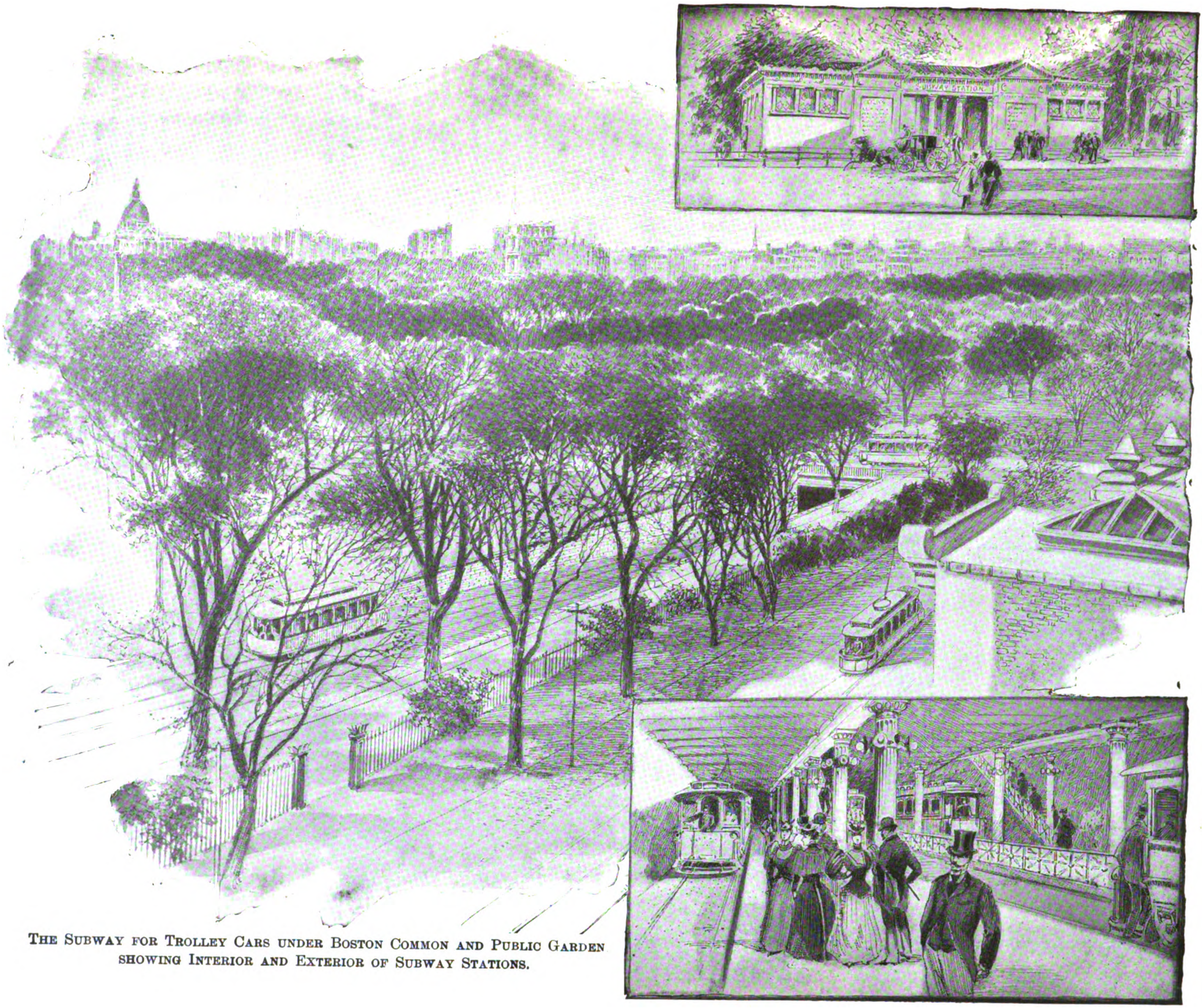
THE city of Boston has probably a greater number of radiating electric street railways than any other city in the United States, and it is noted far and wide for the extent of its street railway accommodations. The very extent of such accommodation, however, has developed a very serious difficulty—namely, that with numerous radial lines converging on a few streets at the centre of the city, some of the busiest streets have such an enormous and continuous traffic of electric cars that vehicular traffic is seriously interfered with, while pedestrians find it difficult and dangerous to cross the streets. The trouble is all the more serious from the fact that many of the streets in the congested district are narrow and crooked, and have a considerable traffic of heavy wagons and carts. These conditions, among others, have led to various propositions for underground and elevated railways, none of which, however desirable as a means of providing additional rapid transit facilities, seemed at all likely to relieve the congestion of traffic of the streets in question. The problem was not one of providing rapid transit for a distance, but of facilitating traffic upon certain existing and stated routes within a very small area about one mile long and ¼ mile wide. After much discussion of the matter, the Boston Transit Com-

FIG. 1.—MAP, SHOWING ROUTE OF BOSTON ELECTRIC SUBWAY.

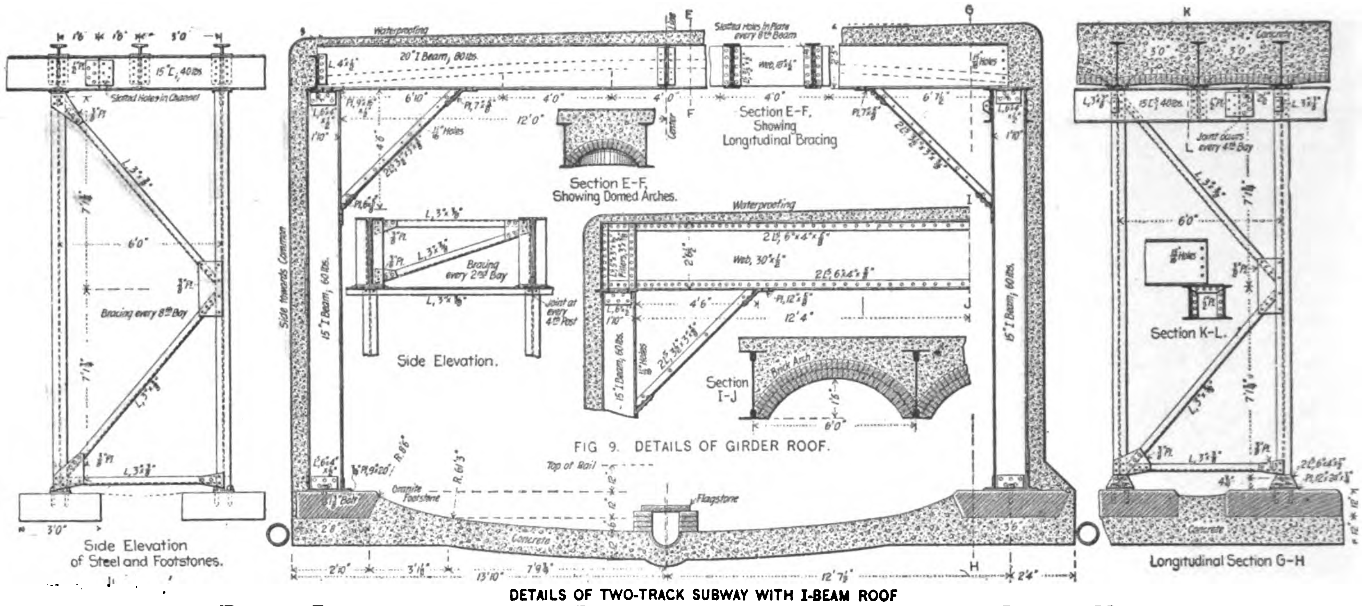
mission decided upon a subway system under certain streets, by means of which the electric cars will be diverted from the surface of the streets on some of the heaviest lines of travel, and will be run underground in a well-drained, ventilated and lighted tunnel, which will, of course, be free from the objections to underground railways where steam locomotives are used.

The methods of construction to be adopted are shown in the accompanying plans, for which we are indebted to the *Engineering News*. Our engraving on page 533 shows the inside and outside of the subway as it will appear when finished.

As shown by the map, Fig. 1, the subway is to commence at an underground station in front of the new terminal station of the Boston & Maine R. R. at Causeway St. The underground station has loop terminal tracks, and from the station two tracks extend along under Haverhill St., while two surface tracks on this street, which connect with the various surface lines converging at this point, begin to descend an open incline approach at Travers St., and reach the level of the other tracks at about Cross St., where the four-track section of the subway will commence, and a station with two island platforms will be built. The four-track subway will extend to near the commencement of Washington St., where it will branch off into two double-track sections, one under Cornhill and the other under Brattle St., which will converge again at a station under the open space at the junction of Tremont St. and Cornhill. From this station a double-track section will extend under Tremont St. to a station at Park St., from which another four-track section will extend along Tremont St. (under the edge of the Boston Common) to a station at Boyls-



THE SUBWAY FOR TROLLEY CARS UNDER BOSTON COMMON AND PUBLIC GARDEN SHOWING INTERIOR AND EXTERIOR OF SUBWAY STATIONS.



DETAILS OF TWO-TRACK SUBWAY WITH I-BEAM ROOF

FIG. 6.—DETAILS OF TWO-TRACK ELECTRIC SUBWAY WITH I-BEAM ROOF, BOSTON, MASS.

ton St. From this station the lines diverge, one double-track subway continuing under Tremont St. to Hollis St., and rising by an open incline to the street level at the junction of Tremont St. and Shawmut Ave., while the other double track turns to the right along Boylston St. (under the edge of the Common) to Park Square and Charles St., whence it rises by an open incline in the Public Gardens to reach the street level at Church St., opposite the Park Square terminal station of the New York, New Haven & Hartford R. R. At the Park St. station of the subway the terminal loop of one pair of tracks will be carried under the other tracks, and at the Boylston St. station one of the Tremont St. tracks is to be carried under one of the Boylston St. tracks, which it crosses, thus avoiding all track crossings at grade. There will be about 5,600 ft. of double-track subway, and about 3,500 ft. of four-track subway. The tunnel will be ventilated by means of fans driven by electric motors, and will be brilliantly lighted by electricity. The section now under contract comprises the open incline from Church St. to Charles St., the double-track subway under the Boylston St. mall of the Boston Common, and the four-track subway under the Tremont St. mall of the Common as far as a point opposite West St. This is the route as adopted by the Boston Transit Commission, of which Mr. Howard A. Carson, M. Am. Soc. C. E., is Chief Engineer.

The profile of the subway is shown in Fig. 2. The grades are

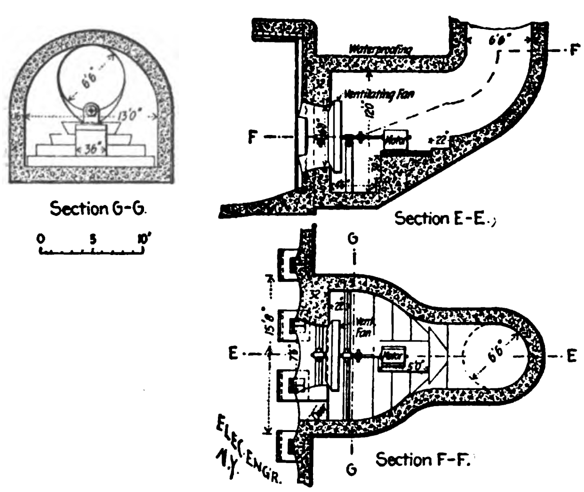


FIG. 7.—VENTILATING CHAMBER, BOSTON ELECTRIC SUBWAY.

8% and 5%, and changes of direction are made by curves of 700 ft. radius on the center line. Vertical curves connect the grades.

In general, the construction will consist of a concrete invert, side walls of steel columns with concrete filling between them, and a roof of plate girders or transverse I-beams, with brick jack arches between them and a covering of concrete. In the four-track section there will be a middle row of steel columns supporting the roof. In the open cuts of the approach inclines the retaining walls will be of concrete, with a facing of masonry in courses about 18 ins. high and 24 ins. thick, battering 1 in 12. The invert is also of concrete, and the invert and retaining walls of the inclines are to be founded on piles, with in some cases, a grillage of 4-in. planks on transverse caps 10 x 10 ins. The width at rail level is 24 ft. 1 in. to 24 ft. 8 ins. These general sections are shown in Figs. 3, 4 and 5.

The cross-section of the double-track subway with I-beam roof is shown in Fig. 6, the clear width between columns being 24 ft., and the clear height above rail level being 14 ft. The concrete invert is 12 ins. thick, increased at the haunches, the upper surface having a radius of 61 ft. 3 ins., ending in a radius of 8 ft. 6 ins. at each side. The rail level is 2 ft. 6 ins. above the bottom of the invert. Along the middle of the invert is a tile drain in the concrete, built up with sides of brick and a covering of flagstones, manholes being provided at intervals.

The ventilating chamber for the double-track section, shown in Fig. 7, is nearly opposite the Public Library, on Boylston St. It is a concrete chamber about 18 ft. wide and 12 ft. long, with a 6-ft. opening into the tunnel fitted with a ventilating fan driven by an electric motor, the air exhausted being discharged through an air duct 6 ft. 6 ins. diameter. The ventilating chamber for the four-track section is near West St., and is a segmental chamber having two fans in separate compartments drawing air from the tunnel through 6 ft. openings, and dicharging it through a duct 11 ft. 6 ins. in diameter. The fans and motors will be furnished and put in place by the commission.

The contract for the iron and steel work has been awarded to the Pennsylvania Steel Co., of Steelton, Pa., and the contract for construction has been awarded to Jones & Meehan, of Jamaica Plain, Mass., at $136,602. The price for the iron and steel work is $39.32 per ton of 2,000 lbs., and as about 1,000 tons will be required the total price will be $39,320, making a grand total of $175,923 for this section of the work. The cost of the entire subway, exclusive of land damages, is estimated at about $4,000,000, and real estate and land damages are estimated to amount to about $1,000,000 more, or $5,000,000 in all.

WORK ON THE BOSTON SUBWAY TO CONTINUE.

At Boston, on June 5, Judge Knowlton, in the Massachusetts Supreme Court, denied the application for a preliminary injunction sought by a number of citizens to stop work on the Boston subway.

MAIL-CARRYING ON BOSTON TROLLEY CARS.

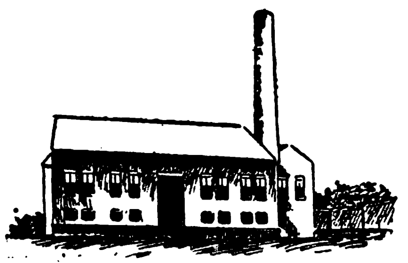
The West End trolley management has issued an order for the carrying of mail in sealed pouches on front platforms of cars on nearly all lines, in addition to that handled by regular mail-cars recently introduced. This is alleged by some employees to be a move to prevent the general tie-up threatened to begin July 5.

AN AMERICAN TROLLEY FOR THE ETERNAL CITY.

A concession has been granted to the Societa Romana degli Omnibus for the building of an electric road to run from the general postoffice to the principal railroad station in Rome. Grades of considerable extent will have to be overcome. The Thomson-Houston trolley system will be adopted, and it is expected to have the line open for business on September 17, this year.

WORK ON THE NANTASKET BEACH ROAD.

Work is being pushed very actively on the conversion of the Nantasket Beach branch of the New York, New Haven and Hartford Road, from steam to electricity. Last week we showed the type of combination motor and baggage car to be used, and we now give a glimpse of "Power House, No. 1," on which work



NANTASKET BEACH POWER HOUSE.

has been begun. The track is now being thoroughly equipped with centre pole construction, and it is interesting to note that steam locomotives have been availed of to assist in stringing the wires and feeder cables. Switch engines have also been used in lifting the big poles into the air by derricks, and dropping them into the holes between the tracks. In this way work that might have taken months has been compressed into weeks and even into days. The grade is also being widened and heavier rails laid. The fare this season for the ride is to be 5 cents, whereas under the old steam conditions it was 15.

LARGE TROLLEY EARNINGS IN NEW ORLEANS.

A report of the earnings of the New Orleans Traction Company for the first twenty-eight days of May shows gross receipts of $108,000. At the rate the earnings are going it is thought that the total for the month will be at least $120,000, or $4,000 per day. The earnings have been steadily increasing for some months, but May will be a record-breaker. The local financiers who bought the stock when it was "way down" are now shaking hands with themselves that they got in at the right time.

ELECTRIC RAILROADING IN PARIS.

An electric railway is to be constructed in Montmartre, Paris. It was originally proposed to build a cable road, but it was abandoned after a commission examined several electric conduit systems. The fare on the railway will be 2 cents, except during the hours when workingmen go to and from their work, when it will be reduced to 1 cent. The road is to be equipped with electrical apparatus constructed in France.

RAILWAY WORK OF THE ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT OF BERLIN, GERMANY.

The catalogue just published by the Allgemeine Eleoktricitäts Gesellschaft, of Berlin, Germany, is deserving of more than ordinary notice, not only because of the beauty of the illustrations and artistic get-up of the work, but also because of the novelties in the installation of trolley circuits in many European cities, which are shown and described. This firm, as is well known in electrical circles, is one of the largest and most influential in Europe. Its head offices and works are in Berlin, and it has branch offices in 22 European cities. Its principal works consist of the machinery department, the wire and rubber department, the armature factory, the glow lamp factory; and its Berlin central station and central offices, as shown in the colored frontispiece of the catalogue, give some idea of the magnitude of the business of the company. The Allgemeine Elektricitäts Gesellschaft has done remarkable work in the running of electric railway lines. Since 1891 it has installed 21 roads, covering 215 miles, and equipped with 582 motor cars. Many of these roads are admirably illustrated in the catalogue. The trolley appears to be popular in Germany. The report of the 33d Annual Meeting of the German Association of Gas and Water Experts states: "At the present time the overhead system is the most practical and the cheapest for electric tramways. These electric lines have proved in practice to be perfectly suitable for efficient working." They seem, too, to manage these things better in Germany. The statistics of "The Great Berlin Tramway Co." show in 1893 one personal accident per 41,625 car-miles. The surmise naturally arises whether the Berlin practice of arresting the person who gets run over has anything to do with this striking record, which compares so strikingly with those of some American lines. The safety of the German trolley lines is not confined to Berlin. Other cities make an equally satisfactory showing, and in Halle there was in 1893 only one person injured upon a running of 88,640 car-miles. Much of the credit of these figures belongs unquestionably to the excellence of the controlling devices with which the motor cars of the Allgemeine Elektricitäts Gesellschaft are equipped, and the cars can be brought to a stand still in the narrow crowded streets of continental towns within the length of a few yards. The sections of some of these narrow streets in, for instance, Gera, Lübeck, Breslau, Essen, and Halle, are most interesting as showing the peculiarity of the wiring of the trolley lines, which is mainly from house to house across the street instead of on poles. The narrowness of these thoroughfares, on which ordinary vehicles are, in many cases, forbidden, is thus turned to an advantage, and the electric cars are run where they would and could not be tolerated were the pole construction necessary. There are many points shown in the catalogue that might be introduced with advantage into American practice.

AIR BRAKES FOR ANOTHER NIAGARA ROAD.

Mr. E. J. Wessels, general manager of the Genett (Standard) Air Brake Co. has been very successful around the Falls lately. A few weeks ago he sold equipments for 30 cars to the Niagara Falls and Buffalo road, and he has now closed a contract for 20, with the Niagara Falls and Lewiston road. It can only be hoped that other places will as quickly fall in line and do the right thing.

TRYING THE PENNSYLVANIA R. R. CO.'S TROLLEY LINE.

A special despatch of June 8 from Mount Holly, N. J., says:

President George B. Roberts, of the Pennsylvania Railroad Company, came here this morning in a special car from Philadelphia, and with a specially selected party of transportation officials made a careful inspection and test of the new trolley line in course of construction between here and Burlington, the road being finished for a little more than two-thirds of the distance, or about five miles.

Three trips were made with one trolley car and an ordinary passenger coach attached, with one-half of the power in use. Everything worked smoothly and in a very satisfactory manner, three trips being made at varying rates of speed, the best time made being 1.45. Part of the distance in the direction of Burlington is a steep grade.

For months the Pennsylvania Railroad Company's officials have been prosecuting investigations along their lines centering in Camden looking to the possible equipment of some of them with electricity, and the branch road between Mount Holly and Burlington is now equipped for the experiments to be made. This branch was selected because of its light freight traffic. As at present operated it makes important connection for through passenger traffic on the main line, but operating expenses exceed the receipts to a considerable extent, which is the case with numerous other short lines. If by substituting the trolley system it is found that expenses can be reduced sufficiently to make the line profitable, the trolley will be introduced on other small branches.

The officials who made the the trips to-day were reticent as to details of their observations, excepting to state that everything proved highly satisfactory, and that all expectations were fully realized.

The fitting out of this short road is a matter of great importance, as the operation of many short, non-paying lines depends upon the results realized, and judging from what could be learned to-day there is strong hope that further equipment will follow.

A THREE-PHASE RAILWAY SYSTEM AT LOWELL, MASS.

THE first application of the three-phase long distance system to street railway work will be made by the General Electric Company at Lowell, Mass., where a plant is in course of construction for the Lowell and Suburban Street Railway Company. Its special features will render it one of the most interesting three-phase installations thus far undertaken.

In the first place, the generators will deliver both alternating and continuous current, and when not in use for transmission work will be run in parallel with the railway generators now in the station. They will be wound for delivery of low voltage current at the alternating side, and this current, raised to 5,000 volts, will be carried to two substations, one nine miles and the other fourteen miles distant from the generating station.

The substations will each be provided with suitable step-down transformers of the General Electric air-blast type, as well as two rotary converters. These machines are constructed to maintain at the commutator brushes an E. M. F. of 5,000 volts at no load, and 550 volts full load. Another transformer substation for 40 incandescent lamps will be installed six miles from the generators.

The success of this plant will go far towards solving the problem of the operation of railways over long distances, taking the current from the one power station. When it is completed we shall present a full description to our readers.

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CONTENTS.

MUNICIPAL TELEPHONY.

SOME of the active spirits of the municipal corporations and County Councils of English towns, encouraged by the successes achieved in municipal control of various public services of a totally different nature have lately been casting envious glances at the telephone, and have viewed with distinct uneasiness the agreement executed two years ago between the Post Office and the Telephone Companies, which gave the Post Office control of all interurban lines, leaving to the companies the working of the local exchange systems. The envy and uneasiness culminated last March in a debate in the House of Commons promoted by Mr. Benn, of the London County Council, who moved for the appointment of a committee to inquire into the whole question of telephony in the United Kingdom. The Government officials firmly declined to consider the agreement as anything but a valid undertaking entered into by the Executive Government, and Mr. Benn's motion was lost, but as a compromise a Select Committee was appointed "to consider and report whether the provision now made for the telephone service in local areas is adequate, and whether it is expedient to supplement or improve this provision either by the granting of local authorities or otherwise."

The Committee consists of fifteen members and has sat, under the chairmanship of Mr. Arnold Morley, the Postmaster General, twice a week since the beginning of April. No counsel is employed at the hearings, but with several legal lights on the committee there is no lack of cross-examining talent, and several witnesses, judging from the reports we have read, have found out that they knew far less about the telephone business at the end of giving their evidence than they thought they did when they began.

The evidence submitted to the Committee may be generally divided as follows: Historical evidence from the Post Office officials showing how the present situation has grown up; for the plaintiff, so to speak, from the ambitious municipalites to show that the present service is inadequate and dear and that they could furnish a cheap and efficient service, or at any rate a cheap one; expert evidence, from Mr. Preece, for the instruction of the Committee; and for the defendant, from actual subscribers to show that the service is good, and from the National Company's officials to show that the Company is fully alive to its responsibilities, is improving its plant as rapidly as it can and that the rates charged are reasonable.

The history of telephony in Great Britain has been very largely influenced by the decision of the High Court of Justice that telephonic communication was telegraphy within the meaning of the Telegraph Act of 1869; therefore the supply of telephonic communication came within the monopoly of the Post Office. The companies formed to operate telephone exchanges had to accept licenses from the Post Office, paying a royalty to that department of ten per cent. on the annual gross receipts from exchange line business. At first the licenses restricted the companies to certain areas; later they were extended to cover the whole country, and, finally, in 1889, the various companies were amalgamated into one, and the telephone system of the entire kingdom came under one management with one policy greatly to its advantage and to that of the public. The Post Office found that the telegraph revenue suffered from the competition of the telephone trunk lines, and in 1892 an agreement was entered into between the Post Office and the National Company whereby the Post Office takes over all the trunk lines and the Company retains the local systems. The Post Office has expended upwards of $1,500,000 in building a new system of trunk lines through the country and will purchase the system of the company at a price of about $2,500,000. Up to the present the trunk lines are operated partly by the Company and partly by the Post Office, but within this year the transfer will be completed and the full scope of the agreement will take effect.

The principal bugbear of the malcontents that have appeared before the Committee is the monopoly that has arisen by the amalgamation of telephone companies and the absorption by the National of the New Telephone Company, which started up a few years ago with wonderful promises of improved service at cheap rates. The monopoly of the National Company is really strengthened by the agreement, as the Post Office engages to issue no further licenses for the whole country and an application for even a local area license must be backed by such conditions as to render it an unlikely eventuality. The evils flowing from the monopoly, according to the municipalites, are high charges and inadequate facilities; the remedies they propose are competition—municipal competition, if possible, but at any rate competition—failing that, nationalization,—the acquisition of the entire telephone system by the Government.

As far as we can judge from the abstract reports of the evidence published by the English journals the municipalites have entirely failed to make out a case. The evidence they presented as to the inefficiency of the service was chiefly of the vague character familiar to every telephone manager, to the effect that "I am always being told that the line is busy," "I frequently have to wait," "I sometimes get the wrong number" and so on. In rebuttal several very large users, subscribers for ten or more lines in different towns, stated that they found the service efficient and considered that they got good value for theis money. With regard to rates the usual meaningless comparisons with rates in cities of other countries were made; comparisons which show nothing unless, as is never done in such cases, all the various conditions involved are also set forth. Estimates were also presented of the expense at which new systems could be established and operated by the municipalities. One of these estimates applied to London; the capital cost of a system of 10,000 subscribers was put at $2,000,000, the operating expenses were set at about $400,000 a year, and it was held that such a system could be worked profitably at a flat rate of $50 a year!

In general, the evidence of the municipalites and their friends showed a total lack of appreciation of the problems involved in operating a large telephone system, and, as was to be expected, complete ignorance of the practical conditions of the business. The greater part of it would have been left without a shred of strength under cross-examination by an expert telephone man or by a well-posted lawyer; and even the cross-examination by members of the committee went far toward showing on what slender knowledge of the subject the pretensions of the municipalites are based. To what extent ignorance of the practical conditions of the telephone business goes even among well-educated electrical engineers was signally demonstrated by Mr. Crompton, President of the Institution of Electrical Engineers and by Prof. Silvanus P. Thompson. Those gentlemen, recognized leaders in their profession, appeared before the Committee to advocate competition on the grounds that the monopoly restricted inventive effort and discouraged young men from starting telephone exchanges on their own account! Mr. Crompton said that among the 2,000 members of the Institution there were only 45 telephone men, of whom 10 lived abroad, 31 were in the employ of the National Company; and 4 living in England were "independent" (We wonder what they do for a living!). Professor Thompson plaintively remarked that about 4,000 young men had attended his classes in the past 10 or 12 years, but very few had come to be instructed in telephony. This simply shows the wisdom of the young men who did *not* apply for telephonic instruction—which is not to be acquired except in actual telephone practice.

Mr. Preece, after delivering a long and generally instructive, if not strictly accurate, lecture on telephony, admirably summed up the objections to municipal competition in telephony. The municipalities would lack experience; efficient service could be provided only when a profit was made; financial failure would incur the opposition of the majority of ratepayers; the skilled labor and expert supervision necessary to high efficiency would be out of reach of small municipalities; there would be lack of uniformity between systems in the same towns—these were the gist of the arguments against municipal experiments with telephony. On the other hand, Mr. Preece thought that the municipalities might do much for the development of telephony by providing subways and conduits and by facilitating the acquisition of way leaves. Cold comfort for the municipalites!

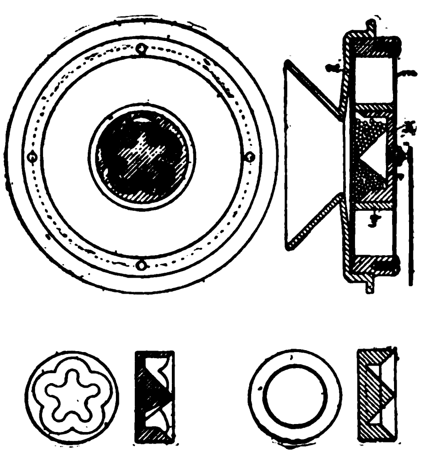
At the time of writing, the evidence for the National Company has not been completed, but, judging from the opening made by Mr. Forbes, the Chairman of the Company, it promises to be most interesting and to provide an effective answer to the flood of loose and frivolous statements poured out by the municipalites. Mr. Forbes showed that since the amalgamation of the companies, the rates had been materially reduced, in some places from $100 to $50, the present rate for all towns except London. The total number of exchanges in the United Kingdom in April, 1895, was 593, of subscribers 75,212, of annual connections 139,639,032. The average rental per subscriber for the whole system was £9. 2. 2. (say $45) and the average cost to the subscriber per connection 1.16 penny (2.32 cents). Regarding improvements to the plant, 117 exchanges comprising 18,978 subscribers' lines were fitted, or fitting, with metallic circuits. Regarding complaints of subscribers, which had been made so much of, the average percentage of complaints per subscriber, annually, was as follows: London 0.94, Manchester 1.56, Liverpool 2.16, Bradford 0.89, Leeds 1.02, Glasgow 3.79, Edinburgh 0.09, Dublin 1.30, Belfast 0.47, and Brighton 0.91. Mr. Forbes dealt with the comparisons with foreign tariffs and showed that if the various conditions were taken into account the differences were easily understood and were not always in favor of the foreign rates, even disregarding the difference in the purchasing power of money.

Whatever recommendations the report of the Committee may contain, we feel moderately sure that they will not be in favor of municipal telephony, and we doubt very much that the acquisition of the National Company's business by the State will be advocated. The arguments against the first are too many and too obvious, and against the second there is one that has crushing weight—the cost. For our part, we find it difficult to evoke or express any sympathy for those who advocate either municipalization or nationalization of telephones or telegraphs. Both services, or industries or whatever one pleases to call them, flourish best under purely commercial conditions that are invariably absent from government management. The government telegraph systems of Europe are notoriously behind the times, and if that of Great Britain be an exception it is because it has chiefly been managed by men who got their hard training as company men, not as government employés. Then, again, we think it grossly unfair after private enterprise has done all the work, has shown what could be done and how to do it, has spent its money and its time in gaining experience, that lookers-on with the tax-payers' money to spend should step in and say, "This must be nationalized or municipalized and you gentlemen can step out and look for something else to pioneer into a paying business." What government but scoffed at the telegraph when it first began its hard struggle for existence? Even with the telephone, did any government take it up until companies had shown what could be done with it? Did the most rabid municipalite in Glasgow or Manchester, or anywhere else, whisper telephone exchange in 1880, when telephone exchange meant experiment, risk and uncertainty? Let the municipalities give us first good roads and clean streets and healthy sewers, and leave telephony meanwhile to the unofficial and inofficious enterprise that has so far done so much with it.

TELEPHONY.

THE MIX & GENEST MICROPHONE.

Among the telephonic apparatus manufactured by Mix & Genest, of Berlin, is a microphone with a granulated carbon, in which a special device has been introduced for preventing packing. The apparatus, as shown in the accompanying illustrations, Figs. 1, 2 and 3, consists of a carbon receptacle K, at the bottom of which is a star shaped pyramid, the front of which is closed by the diaphragm M; the rear plate *m* carries the carbon receptacle K, the open end of which is brought close to the front plate.



FIGS. 1, 2, 3 and 4.

The piece supporting the microphone is screwed into the mouth piece and can be turned so that an occasional turn of the microphone changes the position of the granules. The peculiar shape of the receptacle containing the granules carries the latter with them, bringing them into a new position, and hence preventing packing. When fine carbon granules are used the receptacle can be made in the form shown in Fig. 4, with a roughened surface, and the granules being held in place by means of a felt ring F.

The microphone transmitter shown in Fig. 5 is intended for short private line work. In this instance the carbon powder is confined between two plates of carbon, the whole being enclosed in a small metal box directly attached to the diaghragm of wood, as shown. By loosening the long thumb screws shown, the microphone can be turned and packing thus avoided.

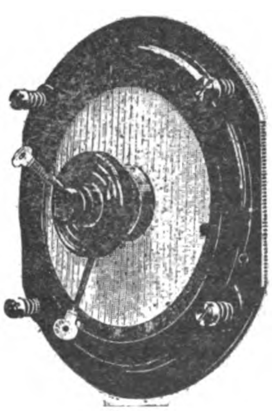


FIG. 5.

ASHLAND, PA.—The Schuylkill Telephone Company has been chartered; capital $25,000.

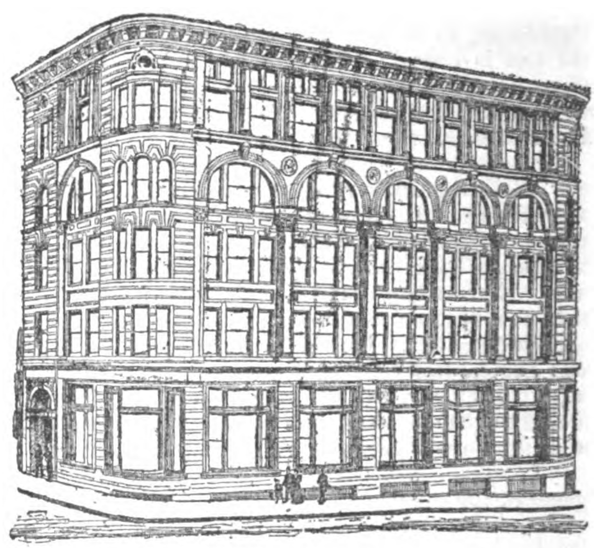
TOPEKA, KAN.—The Harrison Telephone Company has been reorganized under the name of the Topeka Telephone and Electrical Company. The capital stock was increased from $25,000 to $100,000.

ROCHESTER, MINN.—Messrs. Fred. S. Haines and J. A. Melone have closed a contract with Jones & Winter, of Chicago, for the construction of their telephone exchange, and also placed their order for the instruments and switchboard. The system will be in operation by July 15 or August 1.

THE NEW BELL TELEPHONE EXCHANGE AT MONTREAL, CAN.

A new building for the local Bell Telephone Company is to be erected at the corner of Notre Dame and St. John Streets, Montreal. The basement and ground floor of the building will be of terra cotta ashlar, and the upper stories of New Jersey pressed brick with terra cotta trimmings. The dimensions will be 108 feet on St. John st., 85 on Notre Dame st., and 98 on Hospital st., and when completed it will be six stories in height.

Part of the ground floor will be occupied by the local offices of the company, the long distance telephone rooms and waiting rooms. There will be two elevators framed and decorated with wrought iron, and propelled by electricity, at a speed of 350 feet per minute. The first floor will be to let, and the whole of the second; a great part of the third floor will also be to let, and the remainder will be occupied by the battery room, chief operators' room, offices, etc. On the fourth floor is the company's "central." This room is 82 feet wide and 128 feet long, with widows on four sides, as well as large skylights. Here will be located the switch boards and other apparatus connected with the telephone business. This apartment will have a height of 18 feet. Off from this room will be a recreation and lunch room apartment for women operators, the dimensions of the room being 82 feet by 18 feet, and



NEW TELEPHONE EXCHANGE, MONTREAL, CANADA.

still again, a locker room of the same size, containing a steel locker for each of the operators. It is estimated that there will be accommodation for 125 operators.

Besides the messengers' room, located in the basement, there will be a large room containing the distribution boards in which all the wires of the different telephones are assembled, and carried to the operating room on the fourth floor.

The boilers, which are in the basement, will be of the safety water tube pattern, and of about 200 horse power capacity. The electrical plant will comprise two dynamos of 1,000 16-candle power capacity, and special attention has been paid to perfecting the heating appliances of the entire building. The air will be washed and freed from all impurities before being delivered, and a uniform temperature will be maintained at all times. This is the first time in Canada that the application of the system has been made in heating a building such as the new Bell Telephone.

The building will be thoroughly equipped with the most modern fire escapes and appliances, and the cost of it will be in the neighborhood of a quarter of a million. It is expected that the building will be ready for occupation in May, 1896. The architect is Mr. Edward Maxwell.

CLARIDON, O.—The Claridon Telephone Co., has been incorporated with a capital stock of $2,000, and will build a line first from Huntsburg through Claridon to Chardon, to be completed before July 4th.

TALLAHASSEE, FLA.—A telephone manufacturing company with a capital of $10,000 has been organized. The incorporators are W. A. Rawis, George W. Saxon, M. B. Rice and Jas. D. Randall. An exchange is in operation, a line is being constructed to Bradfordville, twelve miles north, and stock is being subscribed for a line to Centreville, ten miles northeast of this city.

TELEPHONE NOTES.

HORTON, N. Y.—The Ontario & Western Railroad will soon build a telephone line from Horton to Cook's Falls.

JACKSON, TENN.—The Forked Deer Telephone Company proposes to build lines in Crockett and Dyer counties.

COLUMBUS, O.—The new telephone company has been granted a franchise.

DANSVILLE, N. Y.—The Dansville trustees have granted to the American Telephone Company a franchise to plant poles and string wires through the village.

FORMAN, N. D.—The Bradley telephone system, with headquarters at this place, has been extended to Lisbon, a distance of twenty-five miles.

HARVARD, ILL.—The directors of Harvard Telephone Company have elected the following officers: H. D. Crumb, president; J. C. Blake, vice-president; F. F. Axtell, secretary and treasurer.

EVANSVILLE, IND.—The Evansville-Harrison Telephone Company has been granted the right to construct and maintain a telephone service in this city.

MALDEN, MASS.—The Malden Telephone Co., a proposed corporation to furnish telephone service in Malden, has petitioned the city government for concessions for twenty-five years.

NEW YORK, N. Y.—The Sullivan County Telephone Company has been formed. Capital, $5,000; directors, Charles Homer, William H. Lawrence, and Edward Homer of Jeffersonville.

GRAND ISLE, VT.—George D. Sherwin, of Burlington, has contracted to furnish and equip a 12-mile telephone line connecting Grand Isle with Alburgh. A cable will be used across the lake at the draw bridge.

TOLEDO, O.—The Commercial Telephone Company of Toledo has filed articles. Its capital is $5,000 in $100 shares. The incorporators are G. R. Struble, L. E. Baker, H. A. Shanklin, S. E. Clapp and Denton Camery.

LENOIR CITY, TENN.—The telephone line between this place and Kingston and Harriman is an assured fact. The poles are now being distributed by Mr. N. H. Greer, of London, who has the contract.

MIDDLEBORO, MASS.—A telephone line is being constructed from Middleboro to Silver Lake, which will touch at Plympton and give residents a connection with the Plymouth circuit and the long distance wires.

WILMINGTON, DEL.—The Delmarvia Telephone Company has been organized in Wilmington, with J. Wilkins Cooch, Anson A. Maher, Mark M. Cleaver, Joseph L. Carpenter, Jr., Daniel W. Taylor and Edwin T. Dilworth as directors.

ISHPEMING, MICH.—The Marquette County Telephone Co. has let contracts for the immediate construction of a telephone system to compete with the Bell system operated by the Michigan Telegraph and Telephone Construction company.

SOUTH FRAMINGHAM, MASS.—The Framingham Telephone Company, organized under Massachusetts laws and capitalized at $150,000, has applied to the Framingham selectmen for the right to introduce a line of telephone service and have a concession for 65 years.

MIDDLETOWN, N. Y.—The Orange County Telephone Company has been formed to operate in Middletown and other sections of Orange county. Capital, $10,000; directors, Lewis S. Stivers, John E. Iseman, Albert B. Wilber, Frank M. Stratton, and others of Middletown.

HANOVER, N. Y.—The Hanover Telephone Company of Silver Creek, Chautauqua County has been formed, to connect telephone lines connecting villages in the Town of Hanover. Capital, $1,000; and directors, R. J. Quale, R. M. Evarts, E. Thomas and others of Silver Creek.

BROOKLYN, N. Y.—The Montauk, Orient and New York Telephone Company of Mattituck has rejected the proposition for consolidation made by the New York and New Jersey Telephone Company, through which 60 per cent. of the stock of the local company was to be transferred to the latter.

AUSTIN, TEX.—The Erie Telegraph and Telephone Co. has completed four copper wires connecting Waco with Austin, Texas. Communication is now carried on over the long distance system of wires between the Texas state capital and all the cities and towns north, including Dallas, Fort Worth, Sherman and as far as Paris, Texas.

NEW YORK, N. Y.—Herts Brothers, of Broadway, who in connection with Mr. Stern, the lawyer, began suit against the Metropolitan Telephone Company some time ago to secure lower rates for their telephone service, have withdrawn their suit, paying all costs to date, and have signed contracts for telephone service at the regular rates established by the company.

FLINT, MICH.—L. K. Mihills has applied for a telephone franchise in this city.

WALES, N. Y.—Stock-holders in the Buffalo Valley Telephone Co. have just received a semi-annual dividend of 5 per cent.

PIERRE, DAK.—The Pierre Telephone Company has begun putting in a plant for Pierre, East Pierre and Fort Pierre. Other towns will be connected later.

LOCKPORT, N. Y.—The Automatic Telephone Co., of New York, has offered to equip Lockport with telephones at $20 a year, provided 300 subscribers are secured on three-year contracts.

LUDINGTON, MICH., has granted J. W. Chase of Grand Rapids, permission to establish a telephone exchange in competition with the Bell company.

DETROIT, MICH.—The Detroit Telephone Company, of Detroit City, Becker county, has been incorporated with a capital stock of $10,000. They purpose establishing a telephone system.

COLLINS, MO.—The Collins Telephone Company has made a contract with A. S. Munsell, of Iowa, to construct a line from this place to Humansville, Mo.

LONG BRANCH, N. J.—The Phœnix Telephone Company, which attempted to get a franchise to operate its lines in Asbury Park is about to establish service at Long Branch.

GAITHERSBURG, D. C.—The Montgomery County Telephone Company has decided to increase its capital stock to $10,000, for the purpose of extending its line to other towns desiring telephonic connection with this place.

POTTSVILLE, PA.—The Pennsylvania Telephone Company has closed contracts for building several telephone lines through the western end of the county. Among them will be one to Primrose and the Lyttle colliery, passing through Minersville, which will be 14 miles in length. Another one will be built to Blackwood, which will be nine miles long.

CLARKSVILLE, N. Y.—At a meeting of the stockholders of the Clarksville and Feurabush Telephone Co., the following officers were elected: President, Cornelius Slingerland, Onesquethaw, vice president, R. C. Bagley, Clarksville; secretary and auditor; C. Hummer, Feurabush; treasurer, Silas Wright, Clarksville; manager, Charles Shear, Clarksville.

STATEN ISLAND, N. Y.—The Staten Island Automatic Telephone Company has reorganized and elected the following officers: James Kerr, president; Dr. J. W. Wood, treasurer; Andrew J. Hinton, secretary; and J. W. Allison, J. C. McGuire, George B. King, C. C. Pucci and Fred. W. Kerr, directors. The company will begin work at once.

WINNEBAGO CITY, MINN.—The Blue Earth Valley Telephone Exchange Company, of Winnebago City, with a capital stock of $50,000, has filed articles of incorporation with the secretary of state. The incorporators are: W. B. Haight, Andrew C. Dunn, C. E. Howe, L. A. Smith, C. H. Patten, David Secor, W. D. Smith, W. H. Hill and W. A. Hinton, all of Nashville, Martin county.

MACOMB, ILL.—The Western Illinois Telephone Company, now building lines all over the part of the state, is thus officered: G. W. Garrison, Industry, president; G. M. Finlay, Augusta, vice president; P. P. Newcomb, Augusta, secretary; L. H. Dexter, Augusta, treasurer; S. P. Lemon, Augusta, attorney. Macomb has granted the company a franchise for a local exchange, the price of the telephones being $20 per year on the commercial circuit and $15 per year on the residence circuit.

READFIELD, ME.—The Readfield Telephone and Telegraph Company has been organized with an authorized capital of $10,000 of which $800 are paid in. The officers are Hon. Emery O. Bean, president; Hon. W. W. Norcross, treasurer, and B. W. Harriman, N. D. Gordon and H. E. Trefethen, directors. It is proposed to build lines from Readfield Depot to Kent's Hill, Fayette and Wayne and from Readfield to Mt. Vernon and Winthrop.

READFIELD, ME.—The Readfield Telephone and Telegraph Company has been organized with an authorized capital of $10,000, of which $800 is paid in. The officers are Hon. Emery O. Bean, president; Hon. W. W. Norcross, treasurer, and B. W. Harriman, N. D. Gordon and H. E. Trefethen, directors. It is proposed to build lines from Readfield depot to Kent's Hill, Fayette and Wayne, and from Readfield to Mt. Vernon and Winthrop.

OWENSBURG, KY.—Articles of incorporation have been filed of the Owensboro Harrison Telephone Company. The capital stock subscribed was $20,000 with the following persons as incorporators: Winfred Carrico, R. Monarch, J. D. Powers, Jas. H. Parrish, Z. T. Robinson, J. W. Slaughter, and others, of Owensboro, and H. K. Cole, of Louisville. The corporation is to commence business on the 28th day of May, 1895, and continue in force for a period of 48 years.

THE WIRE FENCE TELEPHONE IN IOWA.

The wire fence telephone line between Webster City and Williams, Ia., has been discontinued, the Illinois Central Ry. objecting as the line is run on their fence and they say it interferes with the business of the Western Union and their arrangement with that company. The top wire of the fence was used and it worked to perfection. The transmitters and receivers were invented by E. H. Martin, and were a success. An effort will be made to put the line through so that it will not interfere with the railroad.

REVIVING THE BAXTER OVERLAND TELEPHONE.

A special dispatch from Utica, N. Y., June 5, says: The directors of the Baxter Overland Telegraph and Telephone Company had a meeting yesterday afternoon in the office of A. W. Mills in the Arcade, when a committee consisting of C. W. Mather, J. B. Turnbull and A. W. Mills was appointed to obtain, if possible, a dismissal of the injunction against the use of the Baxter telephones which are now stored in the government building. This injunction was to be in force while the patent on the Bell telephone continued. This has never ceased to exist.

EMPORIA, KAS.—The full amount of stock required for the new telephone company has been subscribed.

SUSQUEHANNA, PA.—The Metropolitan Telephone Company is a new organization at Susquehanna to do business in that borough.

SPRING VALLEY, MINN.—The Hogan National Telephone Company, of Chicago, has submitted a proposition to business men of this city that, if 50 subscribers can be obtained and a franchise is granted, it will put in a system.

INCANDESCENT GAS LIGHTING.[1]

BY S. M. HIGHLANDS.

The subject of incandescent gas lighting, and its relation to the gas industry, is a question which would seem to warrant very careful consideration.

The Western Gas Association has been proverbial for its conservatism, but the individuals composing it have been as wide-awake and progressive as those of any other industry of similar magnitude. Several years ago it was rank heresy to mention water gas at our meetings, but the officers of the various companies here represented investigated the merits of the new method of gas making, and the result is that nearly ninety per cent. of the gas made in the West is water gas, and they are again turning their attention to new methods which would seem to promise even better results.

With the advent of a properly constructed gas stove, they were quick to see its merits, and that its proper introduction meant not only largely increased sales of gas, but fortunes for the manufacturers, and to-day the gas company is the exception that does not carry a large line of stoves in a finely equipped show room, with men whose sole duty is to push their sale and use, as far as possible; and none of those who have earnestly tried the introduction of gas stoves have been disappointed.

The gas engine has not met with quite so cordial a reception. After a pretty thorough investigation of its merits, they have found its high cost, low consumption of gas and limited field would not permit of returns sufficiently remunerative to justify their handling them except as an incident, and to supply the wants of a customer who really wanted one.

With the advent of electric lighting came a new element of uncertainty, but a thorough investigation demonstrated two things. First, that there was actually a demand for electric light, and it was here to stay. Second, that there was a fair margin of profit in the business, and the gas companies were the proper parties to handle it. To day no less than 248 gas companies in the Central and Western States are operating electric light plants; and when such companies as the Laclede, of St. Louis, the Cincinnati, the Louisville, St. Paul, Rochester and others, engage in it as extensively as they have done, it demonstrates that the business actually has its merits, and so extensive has been the investment by Western gas companies in the electric light business that this Association might, with propriety, be called The Western Gas and Electric Association.

The foregoing are simply cited as illustrative of the fact that gas men are, as a rule, fully alive to their interests, and ever ready to take up and adopt any appliance or method that will add to their business and consequent profits, and equally able to discriminate against any appliance that would be either detrimental or not sufficiently profitable to warrant their taking up and adopting it either for their own use or the use of their customers.

With the advent of the incandescent gas lamp, we are met with two startling propositions. The first is the introduction of a gas burner, which promises to give an efficiency of 300 to 400 per cent. as compared to those we have been accustomed to. The second is the introduction of a gas appliance through agencies entirely independent of the gas companies.

It is not necessary here to enter into a technical discussion of the Welsbach burner, as it is familiar to all of you, and it is to be presumed that most, if not all of you have experimented enough with it to be pretty well satisfied in your own minds, both as to its merits and its weaknesses.

We, as gas men, have labored long and earnestly to devise means whereby our sales of gas could be increased.

All our reductions in the prices of gas, and they have been many, have had this one object in view, and when these reductions have failed to increase the sales enough to increase the gross revenue, the reductions have been regarded as a business mistake. Our old cold gas benches and apparatus have been discarded and thrown into the scrap pile to make room for improved methods whereby we could make a better gas, and thereby increase our sales. The history of the gas business up to the present time has been one of continued growth and prosperity, giving ample proof that we had successfully studied and managed the interests entrusted to our care. Now shall we, as custodians of these vast interests, adopt methods and appliances whose sole merit is that it will decrease our business and damage the interests which we are expected to protect? The sole recommendation of the incandescent gas lamp is that it will furnish a large volume of light with a small consumption of gas. No one ever pretended that the light is beautiful or pleasant, or the lamp ornamental. On the contrary, it is conceded by all that the color of the light is nothing but a ghastly glare, offensive and painful to the eye. No one ever thought that the rays from the electric arc were pleasing or that it was fit for our houses, churches, or clubs, and that it could be but barely tolerated in the large stores; yet it is a pleasing light as compared with the incandescent gas lamp with which we are most familiar. The only recommendation the incandescent electric light ever had was its convenience, and the beauty and softness of the light, and while admittedly the most expensive light, it has merits enough to make it the most wonderful success this world has ever witnessed. Never before has any new appliance met with such a wide and extensive demand. The short space of fifteen years have been sufficient to thoroughly distribute it over the entire world, and the factories for making the lamps alone, are numbered by the hundreds with individual capacities of turning out many thousand lamps per day, and it is safe to assume that no less than fifty thousand new lamps per day are required to supply the demand for this most beautiful and expensive light. This in itself, is sufficient proof that low price is not absolutely necessary to success. What else than low price of light has the incandescent gas lamp to recommend it? Possibly to use as a competitor of the electric light, but if so to whose advantage? Certainly not to that of the gas company, if the old gas customers are also to be permitted to use it. Were this burner to be generally introduced at once to the present line of gas customers, it would, without doubt, curtail our output for lighting purposes, by at least fifty per cent., and the consequences of this wholesale reduction of the volume of our business, you can picture to yourselves. As managers, how many of you would care to face the proposition? True, the burner has had a limited success in street lighting in some European cities, but the chance of its displacing the electric arc lamp, in American cities, is so remote that it is not worth consideration.

If anything else were needed in this new and much advertised lamp to cause gas men to view it with alarm, it is found in the methods adopted for its introduction. In the majority of cities, special agents are appointed for its sale, who have no connection with the gas company, and any orders the gas company may give for lamps are entirely ignored.

The only possible interest these agents may have in the matter, is to sell the greatest possible number of burners with the least exertion. The easiest and best customers are found amongst the largest gas customers, those whose bills are the greatest. Little if any effort is made by them to sell to users of electric light, and none at all to those who are using oil. Dwelling houses and stores that are not using gas are left severely alone as not being worth bothering with. So far as my investigation goes those gas companies who have successfully met electric competition, and fattened under it, now find their consumption falling off because of the use of the incandescent gas lamp. Their number of consumers may be slightly increasing, but the increase in the number of consumers is more than off-set by the reduction in the bills of their larger customers. The hardest thing in this connection the gas man has to contend with is that he cannot use this burner in working up business among the smaller houses for the reasons: First, he cannot get the burners, and second, they are too expensive for this class of customers to buy, and they are not able to give them the care necessary for their maintenance. Possibly some day we may be able to secure an incandescent gas lamp whose rays will be more pleasing, whose price will be reasonable, and which gas men can buy and sell along with their gas stoves and other appliances to whomsoever will buy. And when that day comes, it may be to our interests to see them introduced, but to-day the electric light and carbon oil lamp are not half so dangerous to the gas man as is the incandescent gas lamp.

1. A paper read before the Western Gas Association, Pittsburgh, May, 1895.

SOCIETY AND CLUB NOTES.

THE NIAGARA FALLS PROGRAMME OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The General Meeting of the Institute will be held at the Cataract House, Niagara Falls, N. Y., beginning on Tuesday, June 25, at 10 A. M. and continuing four days. The following papers will be presented:

1. "The Substitution of Electricity for Steam in Railway Practice," (Inaugural Address,) by the President, Dr. Louis Duncan, of Baltimore.
2. "Properties of Fuse Metals when Subjected to Short-Circuits," by Walter E. Harrington, of Camden, N. J.
3. "Location of Grounds in Armatures, Fields, etc.," by Clarence E. Gifford, of Jamestown, N. Y.
4. "Some Features of Alternating Current Systems," by Chas. P. Steinmetz, of Schenectady, N. Y.
5. "Theory of General Electric Alternating Current Transformer," by Chas. P. Steinmetz, of Schenectady, N. Y.
6. "Compounding Dynamos by Armature Reaction," by Elihu Thomson, of Lynn, Mass.
7. "Existing Commercial Application of Electrical Power from Niagara Falls," by W. L. R. Emmet, of Schenectady, N. Y.
8. "Alternating Current Curves," by Dr. C. E. Emery, of New York.
9. "Electric Power in Factories," by Prof. Francis B. Crocker, Messrs. Benedict and Ormsbee, of New York.
10. "Some Observations on a Direct Connected, 300-Kilowatt Monocyclic Alternator," by Profs. Dugald C. Jackson and S. B. Fortenbaugh, of Madison, Wis.
11. "On Mechanical Models of the Electric Current," by Prof. Brown Ayres, of New Orleans, La.
12. "On the Cause of Death in Electric Shock," by Albert M. Bleile, M. D., of Columbus, O.
13. "Long-Distance Power Transmission at 10,000 Volts," (The Pomona Plant), by George Herbert Winslow, Pittsburg.
14. "Notes on the Reconstruction of a Small Central Station Plant," by Franklin Leonard Pope, of Gt. Barrington, Mass.
15. "On Rating the Performance of Electric Power Plants and Transmission of Varying Loads," by Prof. Wm. S. Aldrich, of Morgantown, W. Va.
16. "Work of the Westinghouse Electric and Manufacturing Co. for the Cataract Construction Co., of New York," by L. B. Stillwell, of Pittsburg.

Among the objects of engineering interest which it is proposed to visit are the new works of the Niagara Falls Power Company. The Niagara Falls Park and River Railway on the Canadian side. The aluminum plant of the Pittsburg Reduction Company. The plant of the Carborundum Company. The central station of the Niagara Falls and Buffalo Electric Light and Power Company.

The date of this meeting has been fixed with a view to accommodating all who may wish to visit the Falls during the most desirable season. Members are requested to invite their friends, either ladies or gentlemen. Should a sufficient number of favorable responses be received, reduced railway rates may be secured. The hotel rate will be $3.00 per day and upwards according to room, at the Cataract House. Those who prefer will find the International convenient.

TRANSPORTATION.

The Convention rate of one and one-third fare for the trip has been granted by the Trunk Line Ass'n., conditional upon an attendance of one hundred members and guests. This covers the Grand Trunk (in part), N.Y.C. & H.R.R.R., West Shore, N.Y.O. & W., Erie, D.L. & W., L.V.R.R., C.R.R. of N.J., P. & R., B. & O., C. & O., Pennsylvania, and other minor lines. Similar concessions are expected from other lines, east, south, and west, the above covering only the territory east of Niagara and north of Pittsburgh, except New England.

1. The members should buy an ordinary ticket and secure from the ticket agent a certificate of purchase. Ample time should be allowed for this purpose.
2. This certificate, endorsed at the meeting, will secure a rebate of two-thirds fare returning over the going route, without stop over.
3. Tickets can only be bought three days before meeting, and the return tickets within three days from close. No tickets or certificates should be sold to scalpers.
4. If certificate is not to be had at small stations, local fare must be paid to nearest certificate point. Every member should secure certificate even if not to be used, as it will aid in securing the concession for others. No rebate will be allowed on fares of 75c. or less.
5. The rebate is dependent upon the attendance of 100 who have paid fare, otherwise no benefit is secured.

Wherever the number warrants, arrangements will be made for a special car. From New York City the following trains and routes are suggested:

N. Y. Central,	1 P.M.,	June 24th,	single fare,	$9.25
West Shore,	6 "	" 24th,	" "	8.00
Lehigh Valley,	6 or 9 P.M."	24th,	" "	8.00

Unless further advised, members should make their own arrangements for berths, chairs and rooms. Non-members are cordially invited to attend.

Any friends of the Institute desirous of joining it upon this important and interesting occasion, should at once communicate with Mr. R. W. Pope, the secretary, Havemeyer Building, New York City.

MUNICIPAL LIGHTING RATES AT NORTHFIELD, VT.

The village of Northfield recently voted to put in a municipal electric light plant at a cost of $25,000, or over. Water supplemented with steam power will be used. This plant is not yet in operation, but a schedule of rates has been agreed upon and is given below. The rates given are per annum and for incandescent lights.

Stores, offices, etc., each light	$3 00
Stores, offices, etc., in cellar or back room	2 00
Hotels—First light in each room except sleeping rooms	3 00
Hotels—Extra light in each room, except sleeping rooms	2 00
Hotels—First light in each sleeping room	2 00
Hotels—Extra light in each sleeping room	1 00
Hotels—Each light in bath room or water closet	3 00
Hotels—Each light in barn or livery stable	3 00
Public halls—Each light	2 00
Public halls—Each foot light	1 00
Churches, school houses and society halls—each light	1 00
Private houses—First light in each living room or hall	3 00
Private houses—Extra light in each living room or hall	1 50
Private houses—Each light, barn, shed, or cellar	1 00
Private houses—First light in bath or sleeping room or pantry	1 00
Private houses—Extra light in bath or sleeping room or pantry	1 00

Meter rates:—One-third of a cent an hour per light with minimum rate of $35 per year for stores, $14 per year for all others, except churches and society halls which have a minimum of $10 per year. Meters of ordinary size cost about $14; these to be furnished by owner of house, or by the village at rental of 10 per cent. of cost with privilege of buying.

ELECTRIC LIGHTING DEVELOPMENT AT NEWARK, N. J.

The Newark (N. J.) Electric Light & Power Company, which some years ago passed into the hands of a syndicate of Newark, New York and Philadelphia capitalists, has been sold to Philip N. Jackson and B. M. Shanley of Newark. The old syndicate included Mr. Shanley, John D. Crimmins and other street railroad magnates, who had acquired control of the Newark street railway interests. One object of the syndicate was to have the lighting company assist the railway company with electric power, but this arrangement never amounted to much. City contracts were obtained, however, and the use of incandescent lights in stores and private houses has been generally extended. The company has been paying 6 per cent. dividends, and last April paid a stock dividend of 10 per cent. The authorized capital is $1,000,000. but the total stock issue is only $825,000.

Messrs. Jackson and Shanley, who now control the company, will reorganize it, change its name, and, with new capital, will introduce electric lighting more generally than ever in the city, and extend it to the cities and towns surrounding Newark. It is likely, too, that the cost of electric lighting will be lessened to the consumer.

THE MATHER SCHEME OF UTILIZING THE NIAGARA RIVER.

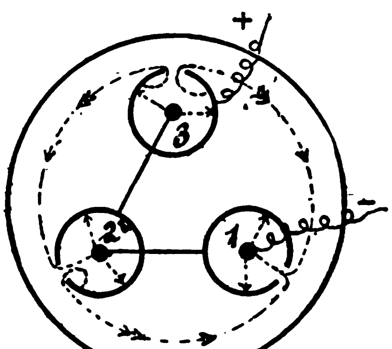
Mayor Jewett, of Buffalo, has signed the bill authorizing Alonzo C. Mather, a Chicago inventor and engineer, to make experiments in the Niagara River near that city, looking to the utilization of the swift current of the river for the generation of electric power. Mr. Mather will expend it is alleged $100,000 on the enterprise. His proposition is to span the river with a bridge between the steel piers of which undershot water-wheels, forty feet in diameter and capable of being raised or lowered, will be suspended. The river flows at the rate of seven hundred feet per minute.

Before the bridge can be constructed the consent of the War Department and the Canadian government must be obtained.

LETTERS TO THE EDITOR.

THE BOYNTON MULTIVOLT PRIMARY BATTERY.

PROFESSOR Anthony's estimate of the Boynton battery appears to me entirely correct. I can see no particular advantage in setting up three cells in one jar instead of three cells in three jars. There is no gain in first cost, because two glass jars would probably cost less than the hard rubber insulation on the carbon cups. On the other hand there is a decided loss in the inevitable waste of current between the jars internally. The description published in several electrical journals is beautifully indefinite, but it is assumed here that the three cells are connected in series in the usual manner. Let the accompanying figure be a plan of the jar



containing the three cells. Then the several paths of the current through the liquid is shown by the arrows. The most important leakage or waste current would be between the zinc of cell 1 and the carbon of cell 3, since the potential difference between these parts is the whole E. M. F. of the battery. There would also be leakage between the carbons, as pointed out by Professor Anthony.

One point not alluded to by Professor Anthony is the following: If as large a current as possible is drawn from this combination of three cells in one, by making the external resistance as low as possible, then the waste is reduced to the lowest percentage. But with a large external resistance, the percentage of loss is much larger. The circular of the company exploiting this cell claims among other things "No local action, no polarization, no heat." Of course such a claim is mere buncombe and has no foundation in fact.

HENRY S. CARHART.

ANN ARBOR, MICH.

MAGNETIZATION OF RAILROAD SIGNALS.

In THE ELECTRICAL ENGINEER of May 22, I notice a communication from Mr. H. Wellman, in reference to the "Magnetization of Steam Railroad Signals."

I should look for the explanation, in the relative positions of the levers, and the street railroad rails. The rails being the return circuit, are, of course, surrounded by lines of force, the same as any other live conductor, and the levers, standing at right angles to the rails, form what might be termed the core of a magnet.

He says the tops of the levers are north poles, and the lower ends south poles. Let the current be reversed, and see if the polarity remains the same.

JOHN E. ADAMSON.

POMONA, CAL., May 28, 1895.

AMERICAN PRIORITY IN TELEGRAPHING WITHOUT WIRES.

Under the above heading Prof. Dolbear in the ENGINEER of May 29 gives an interesting bit of electrical history and shows commendable national pride in claiming this to be an American invention. Some nine years *after* Prof. Trowbridge's demonstrations, I reinvented the same method, and thought of applying for a patent protecting it. On examination I found the scheme to be nearly as old as the telegraph. I am not certain now where I saw the reference, but am under the impression it was in the first or second volume of the British Electrical Patent digest. The theory of this system can easily be explained without bringing in the much abused and mysterious word "induction." Say we have two parallel grounded telephone wires 5 miles long, one-quarter of a mile apart, separated by water if you choose, conversation on one line may be heard on the other; this fault is generally attributed to induction, a sort of magnetic influence. The real explanation is that electric currents *must have a complete circuit. They follow the path of least resistance.* The resistance from the terminal of one of the wires via the earth or water one-fourth of a mile, thence back by the other wire, is less than it would be through five miles of ground return, consequently we hear the cross talk. It could not be otherwise. To avoid it telephone companies use complete metallic circuits.

JNO. C. HENRY.

PUEBLO, COL., June 3, 1895.

TELEGRAPHING WITHOUT WIRES.

Concerning the question of telegraphing without wires referred to in Prof. Dolbear's article in the last number of your Journal, I desire to call attention to British patent granted to Thomas Boman Lindsey, No. 1242 of 1854, in which is fully disclosed the system referred to in Prof. Dolbear's article. If I recollect correctly, Prof. Morse also made a number of experiments in one of the canals near Washington, some time between 1840 and 1850; at any rate I have an indistinct recollection of having read, I think in the Journal of the Franklin Institute, a description of such experiments.

C. J. KINTNER.

NEW YORK CITY, June 5, 1895.

MARRIED.

MOORE-ELLIOTT.—Mr. D. McFarlan Moore, the inventor, who has been of late devoting his attention specially to the perfection of phosphorescent lighting, was married on June 5 to Miss Mary Alice, daughter of Mr. and Mrs. John Elliott, of this city. The wedding took place at Trinity Church, Harlem. Mr. Moore will take up his residence at East Orange, so as to be near his laboratory.

MR. JOSEPH VON SACHS was married to Miss Caroline Norman on June 5. Mr. Sachs is one of the rising electrical engineers in New York City, and has already made a number of highly ingenious inventions. His lectures before the electrical Societies have also made him known. He is one of the authors of the recent book on "Electrical Boats and Navigation." The happy pair have the congratulations of many friends.

PERSONAL.

MR. ARNOLD SPILLER, who for some years past has been the electrician and factory superintendent of the Buckeye Electric Co. of Cleveland, has recently resigned his position with the object of enjoying a long rest at home in England and in continental travel. As the lamp expert who introduced to this country the modern cellulose filament, now so universal, Mr. Spiller has naturally seen some most interesting changes in the art with which he is so prominently connected; and he has also had the pleasure of knowing that he has lifted the product of his own Company to a high pinnacle of reputation for all qualities of excellence. Mr. Spiller can ill be spared, and it is to be hoped that a few months' may again see him back in America to resume work that has been done with so much zeal and ability. It may not be generally known that Mr. Spiller is a chemist as well as electrician; and he is at the present time a student of the newer problems in thermo-electric chemistry.

MR. THEODOR KOEHN.—We are glad to note the visit to the United States of this gentleman, who is one of the directors of the Union Elektricitäts Gesellschaft. He is accompanied by one of his engineers, and they are looking over what is being done in this country in the way of electrical engineering and manufacture. Mr. Koehn is also a director in the celebrated German firm of Ludwig Loewe Co., makers of small arms, machine guns and ammunition.

"WIDE AWAKE."

The following is from a leading supply house in the West. "Your little 'Cold Snap' article hits the nail on the head exactly. Incidentally I will say that I do not know of any electrical periodical that just at present, or in fact at any time, seems to be wider awake to the electrical situation than the ENGINEER. This is a fact, and not friendly fiction."

A COLORADO READER writes us:—"Your issue of May 29 is a daisy." Thanks.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 4, 1895.

Telegraphs:—

Telegraphy, C. R. J. Willot, Paris, France, 540,477. Filed April 24, 1894.
Relates to a telegraphic system, whereby the dashes or strokes employed in the Morse code may be transmitted at the same speed as the dots; applicable more particularly to submarine cables.

Telephones:—

Telephone System, W. W. Dean, St. Louis, Mo., 540,239. Filed Feb. 21, 1895.
Means for testing at one of the multiple boards to determine whether a line is busy and a connection has been made therewith at another of the multiple boards.

Alarms and Signals:—

Electric Burglar Alarm, J. Tomney, New York, 540,341. Filed May 2, 1892.
A circuit changer for bringing into circuit temporarily a predetermined resistance at the time of closing up the guarded premises.

Contact Post, R. Segerdahl, Chicago, Ill., 540,367. Filed Mch. 29, 1894.
An electric bell contact post designed to maintain a perfect electrical connection between the circuit wire and the movable contact.

Signal Transmitting Apparatus and System, H. A. Chase, Boston, Mass., 540,422 Filed Sept. 1, 1892.
Relates to a system and apparatus for the transmission of signals, adapted to be used as a combined fire and police telegraphic system.

Electrically Controlled Speaking Tube, G. S. Williamson, McKeesport, Pa., 540,529 Filed Feb. 18, 1895.
Consists of a whistle enclosed in a casing having a speaking tube inlet and a mouth piece, a valve for controlling the connection between the mouth piece and whistle, and an electric circuit provided with electro-magnets and having an armature lever controlled from the whistle.

Electrical Signaling Apparatus, B. A. Fiske, United States Navy, Reissued, 11,498. Filed Oct. 23, 1894.
Consists in the novel construction and arrangement of the transmitting and receiving instruments, and in their combination in circuit.

Conductors, Conduits and Insulators:—

Underground Electrical Conductor and Method of Manufacturing Same, J. H. Croskey & J. Locke, Pittsburg, Pa., 540,540. Filed Jan. 17, 1895.
A conductor inclosed in a solid mass of glass which is, in turn, inclosed in a metallic envelope.

Distribution:—

Electric Regulator, J. McKim, Weir, Kan., 540,557. Filed Sept. 12, 1892.
A novel construction of alternating lighting dimmer.

Dynamos and Motors:—

Electromagnetic Winding, O. P. Loomis, Bound Brook, N. J. & C. A. Pierce, Lynn, Mass., 540,238. Filed Mch. 9, 1895.
Consists of a metallic tape that can be wound in turns or coils of any desired shape.

Dynamo Electric Machine, G. De Camp, St. Louis, Mo., 540,351. Filed Sept. 24, 1894.
A compact machine especially adapted for locomotive head light work.

Electric Motor, F. Pearce, New York, 540,456. Filed Dec. 3, 1890.
Dispenses with the commutator and brushes in showcase motors, having soft iron star shaped armatures.

Electric Heating:—

Electric Heater, E. E. Gold, New York, 540,244. Filed Jan. 29, 1895.
Details of construction of an electric car heater.

Electric Heater, J. E. Meek, Denver, Colo., 540,398. Filed Feb. 5, 1894.
Consists of a resistance wire woven into asbestos cloth.

Lamps and Appurtenances:—

Electric Arc Lamp and Carbon, C. A. Pflugler, Chicago, Ill., 540,333. Filed Oct. 18, 1894.
Claim 1. In an arc lamp the combination of the feeding mechanism with two carbon electrodes each of which is oblong in cross section and formed of carbon having a varying texture from the external surface towards the center.

Electric Arc Lamp; H. Radcliffe, Milwaukee, Wis., 540,404. Filed Mch. 19, 1895.
Details of construction for theatre arc lamps.

Miscellaneous:—

Apparatus for Extinguishing Fires, J. G. Lorrain, London, Eng., 540,264. Filed Sept. 23, 1893.
Improvement on Patent No. 501,519, by same inventor. Relates to a sprinkler.

Paper Registering Machine, T. C. Dexter, Pearl River, N. Y., 540,352. Filed Aug. 8, 1894.

Electric Gas Lighter, G. W. Shepherd, Philadelphia, Pa., 540,463. Filed Mch. 13, 1895.
An electric gas lighter that can be used in connection with the incandescent Welsbach gas burner.

Apparatus for use with Electrically Illuminated Signs or Advertisements, E. L. Berry and F. Harrison, London, Eng., 540,480. Filed Nov. 21, 1894.
The combination with an electric sign of two or more circuits, and a switch provided with contacts arranged to break contact with the brush alternately at opposite edges of the brush.

Apparatus for Electrically Purifying Water, G. M. Collier and R. T. Deilefs, Cleveland, Ohio, 540,608. Filed Nov. 10, 1894.
First heats the water and then electrolyzes it to eliminate the elements which form the scale in boilers.

Railways and Appliances:

Closed Conduit Electric Railway, M. F. Flynn, Stamford, Conn., 540,305. Filed July 28, 1894.
Details of construction of a system embodying surface contact rails.

Electrical Trolley for Canal Boats, A. C. Mather, Chicago, Ill., 540,325. Filed Dec. 1, 1893.
The object is to provide a trolley which will hold close to a double wire or conductor, and yet so constructed that it will act as a guide in connection with the double conductor wire or plates

Trolley Pole with Locking Wheels, T. Thompson, Newark, N. J., 540,340, Filed Oct. 29, 1894.
Wheels adapted to grasp the opposite sides of a trolley wire which is attached to its supports upon its upper side.

Trolley for Electric Railways, T. Euphrat, Darien, Conn., 540,486. Filed Mch. 5, 1895.
Relates to means of lubricating trolley wheels and to mounting them for readily substituting one for another.

Ice Detaching Trolley for Electric Railways, T. Euphrat, Darien, Conn., 540,487. Filed Mch. 23, 1895.
Claim 1. A trolley wheel having a groove of about equal depth as the radius of the conducting wire, and formed on a slightly larger radius in combination with a housing block.

Conduit Electric Railway System, C. M. Allen, San Francisco, Cal., 540,569. Filed Oct. 3, 1894.
Consists in a novel means for transmitting the current from a main conductor to the moving car by means of a series of successive contacts, which are made as the car passes and are broken immediately after.

Switches and Cut-Outs, etc.:—

Electric Switch, J. O. Heinze, Jr., Lynn, Mass., 540,258. Filed Dec. 4, 1894.
Details of construction of a quick-break knife switch.

Automatic Switch, A. H. Hobart, Bridgewater, Mass., 540,442. Filed Oct. 6, 1894.
Combination of a clock and switch which is thrown at a predetermined time.

FORMATION OF THE TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

In accordance with announcement already made, a meeting of the gas and electric men of Texas has been held, at Houston, at which an association with the above title was formed. The officers elected were W. E. Holmes, of Austin, president; P. Bauer, of Texarkana, vice president; Homer Starr, of Gonzales, secretary and treasurer. Mr. C. D. Braun, of Galveston, and Mr. T. D. Miller, of Dallas, were elected members of the executive committee for two years; and Mr. L. T. Fuller, of Calvert, and J. H. Fitzgerald, of Houston, members for one year. The annual meeting will be held in May, 1896. The entrance fee is $5 for active, $2.50 for associate, which covers dues for first year. The regular dues will be $3 and $2.

BIDS WANTED AT BELLEFONTAINE, O.

Specifications for the municipal electric lighting plant at Bellefontaine are on file at the Mayor's office and at the engineers, E. P. Roberts & Co., Cuyahoga Building, Cleveland. No copies will be sent out. Bids close June 25. The material wanted is two arc dynamos of a total capacity of 100 lights, with lamps and line complete; also an alternating dynamo and converters of 650 lights capacity, erected complete. The steam power is to consist of a 100 H. P. steam engine, and one of 60 H. P.; two 60 by 16 boilers; heater, pump, injector and piping; gas engines of 150 H. P. in two or three units, with shafting. Stamped envelopes should accompany all inquiries.

LEGAL NOTES.

APPEAL IN THE THOMSON-HOUSTON BRUSH REGULATOR.

THE appeal of the Thomson-Houston Electric Co. against the Western Electric Co. on the automatic brush regulator for arc dynamos came up before the U. S. Circuit Court of Appeals in Chicago on June 1, Judges Woods, Jenkins and Showalter on the bench. This appeal, it will be remembered, was taken from the decision of Judge Grosscup, who decided against the patent on the ground of lack of invention. Messrs. F. P. Fish, R. S. Taylor, C. K. Offield, H. S. Towle and C. C. Linthicum appeared for the Thomson-Houston Co., and Messrs. G. P. Barton and C. A. Brown for the Western Electric Co.

FINANCIAL.

NEW YORK EDISON BONDS IN BIG DEMAND.

The $1,086,000 Edison Electric Illuminating bonds offered for sale by J. P. Morgan & Co. and F. S. Smithers & Co., were subscribed for twice over in less than half an hour. Subscription books were opened at 10 o'clock on May 31, and officially closed before 10.30 o'clock. The confidence thus shown in local electric lighting enterprises is regarded with much pleasure throughout electrical circles.

A WAITING MARKET.

THE stock market is slowly settling down to midsummer dullness, and not until the condition of the crops is better known will there be much movement one way or the other, although the advance of the season witnesses a steady if sometimes slight gain in confidence and a general revival of trade. The conditions are all for betterment, and in the aggregate will give an impetus to business this fall that will be irresistible even should the crops not be the fattest the country has ever had.

General Electric stock enjoyed quite a little boom of its own last week, 42,243 shares being sold and the price going up from 35⅜ to 36½, the highest point reached being 37⅜. No particular reason has been assigned for this except the alleged resumption of negotiations between the General Electric and Westinghouse Companies. Only 9,499 Western Union shares were sold, closing at 94¼, one-eighth less than a week ago. Bell telephone has remained steady.

COMBINATION OF LIGHTING PLANT AND WATER WORKS, MONROE, LA.

It has long been the fashion to unite electric lighting plants with gas works, so that to-day there are at least 250 companies in the Central and Western States alone, operating the two systems of illumination. More lately it has come to be the practice also to associate electric lighting with water works, especially where both plants are under municipal control. It is obvious that in small cities, and under municipal management, considerable economy should be possible with such an arrangement; and the new installations of this nature are being studied with deep interest by electrical and civil engineers, for there also opens up, as we have already indicated once or twice, the possibility of pumping by electric power when the conditions do not favor the direct application of steam.

We are glad of the opportunity here to illustrate the plant at Monroe, La., where the latest ideas in this respect have been tried, and to supplement the data by two views kindly loaned us by *Fire and Water*. The plant is owned by the Monroe Water Works and Light Co., of which W. E. Hawks, of Bennington, Vt., is president, and S. B. Hawks, secretary. The power house is built of brick and the dynamo room is 32x74x32, with mansard truss roof supports, covered with slate and tin. The walls are plastered and

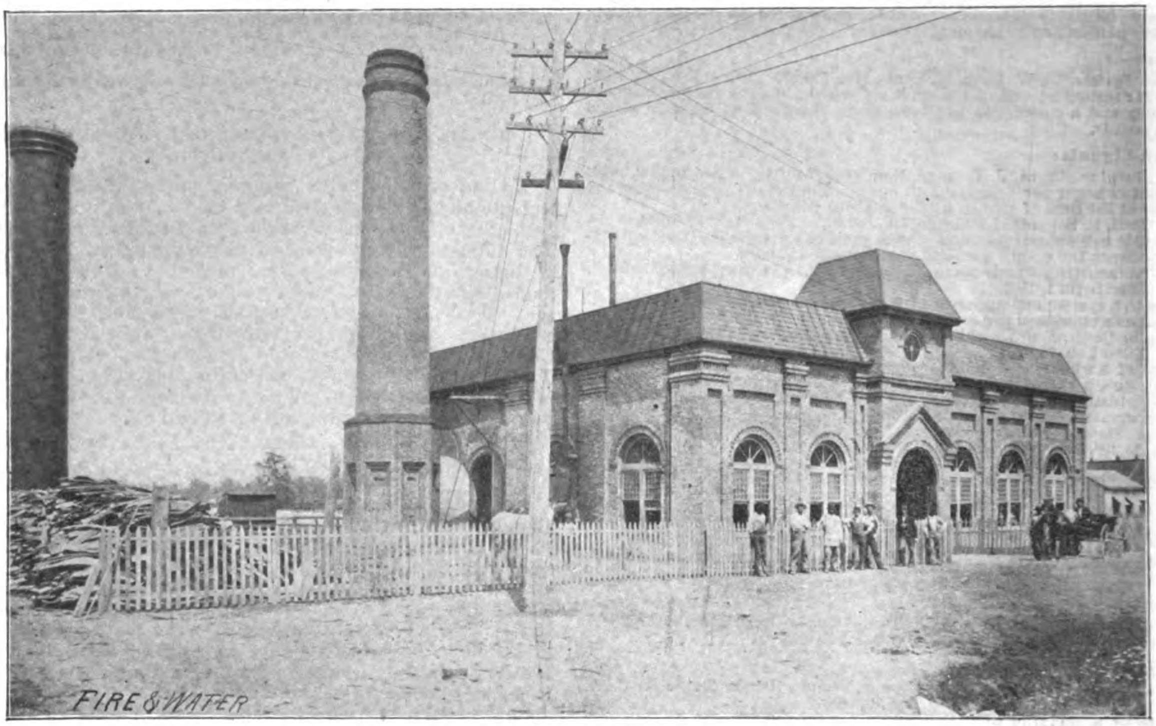


Fig. 1.—Power House, Monroe, La., Lighting and Water Works.

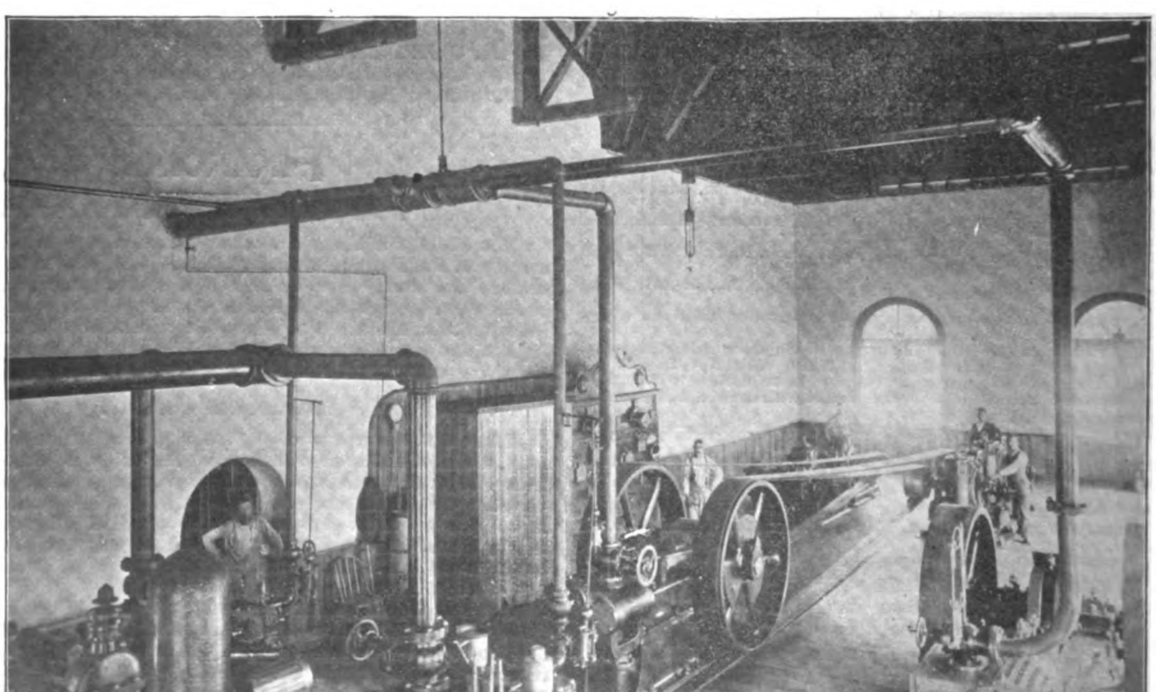


Fig. 2.—Engine and Dynamo Room, Monroe, La., Plant.

attractively finished. The wainscotting and floor are of yellow pine, finished in hard oil. The building contains two 50 light Standard arc machines, two 500 light National incandescent machines; one 50 H. P. Westinghouse multipolar generator; one 150 H. P. Ideal high speed engine; one 150 H. P. Armington & Sims high speed engine; two Worthington compound pumps with a capacity of 2,500,000 gallons every twenty-four hours; one National 200 horse power feed water heater; two boiler feed pumps, and all the necessary electric switch boards and connections. All the machinery is set on solid masonry foundations.

The boiler room is uniform in style of architecture with the dynamo room, and contains four Watertown boilers of 100 horse power each. The stack is brick, seventy feet high. The floor is of Portland cement. The fuel room is of brick 26x29 feet, separated from the boiler room by heavy iron doors. The fuel is shavings blown through a galvanized iron tube from a planing mill some 500 feet distant.

The plant is provided with regulation two and a half inch hose, by means of which even the remotest corners are amply protected against fire. The standpipe is 120 feet high and sixteen feet in diameter, and gives a domestic pressure of sixty pounds. A reservoir 100 feet square and nine feet deep, containing about 900,000 gallons of water is kept in reserve in case of fire. Then the standpipe is cut off and direct pressure applied to the mains, the Worthington pumps are used and as much pressure given as is required. The best results are obtained under a pressure of from 100 to 125 pounds.

The company first supplied water from artesian wells for domestic use, but upon being convinced that river water was sufficiently wholesome, began considering the best means of pumping. Electric pumps were proposed, and the whole matter was put into the hands of the secretary of the company (S. B. Hawks) to investigate and contract for whatever he found best suited to the needs of the situation. The company finally contracted with the Westinghouse Electric Manufacturing company for a fifty-horse power, 500 volt direct current, multipolar generator, and with the Goulds Manufacturing company of Seneca Falls, N. Y., for a special make of their triple pumps, spur-geared to a slow-speed fifteen-horse power Westinghouse motor. The capacity of the pump is about 400 gallons a minute, or 840,000 gallons in twenty-four hours.

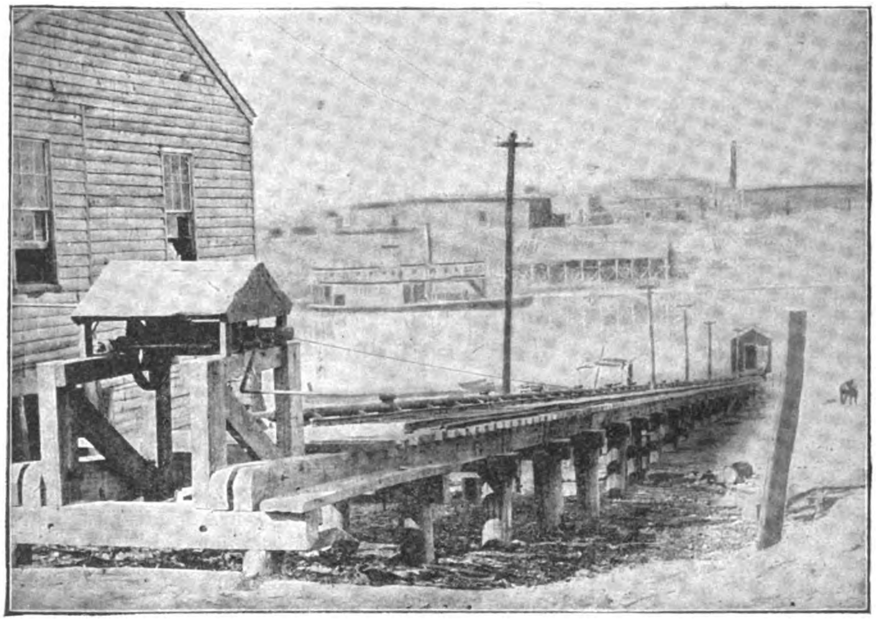


Fig. 3.—Method of Pumping River Water Electrically, Monroe, La.

There is a difference of forty-eight feet between high and low water, and the pump is set on an incline, constructed by driving piles twelve feet apart, and upon these is laid the railroad, nearly five hundred feet long. There is a car twenty-eight feet long, twelve feet of which carries the covering for pumps and the remainder holds the suction pipe. The discharge pipe is held in place by extra long and heavy ties, and is fitted with twenty stations of flanged joints, with a cap on each, which is taken off when the pump reaches that station. The car is moved by means of a hand derrick and wire cable, and the whole car is so braced that vibration is prevented and the operation of the pump is almost noiseless. (See Fig. 3.)

Not content with the plant already in operation, the company contemplates important improvements in the near future, including furnishing power for a trolley railway, and later furnishing electricity for heating and cooking. It is certainly situated advantageously for the generation of cheap current, and can go out boldly looking for consumers to whom it can offer attractive rates. And what has been done at Monroe, La., can be done at many other places in this country.

Milwaukee, Wis.—The Milwaukee Electric Manufacturing Co. has been formed by John E. McKivitt, M. Weisser, J. C. Schmitt and H. W. Newton, with a capital stock of $8,000.

THE POSSIBILITIES OF ELECTRICAL PUMPING MACHINERY.[1]

BY CHARLES A. HAGUE.

The pumping of water by means of the power derived from the electric current, has, as you are aware, already been accomplished upon a limited scale; and in considering this fact I have been led into a line of thought upon the subject that has gradually opened up possibilities and probabilities for the future, embodying a magnitude and economy not yet approached in practical operations.

The convenience and controlability of electrical power, together with its simplicity of application to the work of pumping, commends it very strongly for use in isolated places, such as high service systems in public water supply, wherein a comparatively small percentage of the total water supplied by the initial plant is needed for dwellings situated upon levels too high to be accommodated by the general pressure, and the question of course arises whether we shall put the entire system of the city under the highest required to force a supply to these higher levels, thereby placing a large portion of the mains and fixtures under an unnecessary strain, while operating under wasteful conditions of pumping power, or whether we shall isolate the higher levels and handle the smaller percentage of water by itself.

This phase of water supply is not new to you, and indeed many of you no doubt have now under your call, high service plants, but I start out upon this line so as to bring to your attention a state of things with which you are familiar, to which you can readily adopt the electrical idea in a practical and useful manner, and from which you can all the more readily become reconciled to the problem of pumping the main supply when the time arrives, by means of the mysterious and convenient mode of power now rapidly taking its place in the world of available energy. The portion of my subject relating to high service supply is a living question now perfectly practicable and applicable, destined without doubt to be largely employed in the near future. The application of electrical energy to the pumping of the main supply of a city of considerable size, although presenting many attractive features as far as the actual operation of the pump is concerned, is not yet within the possibilities on account of the absence of inexpensive methods for producing the necessary electric current, so that apparently in pumping large quantities for some time to come, compound, triple and quadruple steam pumping engines will hold sway. But the matter of transforming the energy of falling water by means of the turbine, and upon a large scale, with electrical energy at the end of a copper wire, is awakening interest far and wide to-day. It is beginning to offset very forcibly the proposition that it does not pay in the present state of perfection of the steam engine to go very far out of the way of regular commerce, to get the cheap power afforded by a falling stream. But when, as now, the stream can be made to infuse into a wire the vital spark of energy, through the medium of generating machinery situated at the fall itself, when it is possible to convey this energy so to speak, to any desired point, even using the trees of the forests to support the wires, then the items of railroad tracks, transportation of fuel, of raw materials, and of finished products between the falling stream and a good market are wiped out of the equation. Imagine, if you can, a comparison between the transportation of supplies necessary to maintain a power station, and the transportation of the entire materials and products of manufacture.

To bring the problem of high-service pumping down to figures and familiar terms, suppose that a city's total supply is ten millions gallons a day, and that one million gallons only are needed

1. Read before the American Water Works Association, Atlanta, Ga.

for a district which would make it necessary to deliver its supply under a pressure of 125 pounds a square inch if delivered from the main pumping station, while the remaining nine millions only needed a pressure of seventy-five pounds for distribution. Then the difference in power would be as follows: The entire ten millions under the 125 pounds pressure represents 500-horse power, while the nine millions under seventy-five pounds pressure represents only 270-horse power; and the one million under the high-service pressure of 125 — 75=50 pounds pressure represents only 20-horse power. The economy of power, then, would be 500 — (270 + 20) = 210 horse power saved by dividing the service.

How convenient it would be to generate an electric current at the main pumping station, with the boiler plant used for pumping the main water supply, then run the wires up to a point adapted to the high-service pumpage, and operate an electrical-driven pump. Of course a high service steam-pumping plant could be installed at the proper point, but that would mean expensive attendance, hauling of coal, ashes, supplies, etc.; and last, though by no means least, large quantities of smoke and dust spread over what are generally residence districts. There are cities where pumping plants are supplied with anthracite coal at double the cost of bituminous coal, to quiet the complaints of the owners of lawns and trees.

Glance for a moment at the saving in fuel shown by dividing the service as set forth above. The case supposed is extreme, but extremes illustrate ideas forcibly, and there are probably cases in actual practice equals of the ones supposed. Allowing that an economic duty of one hundred millions is obtained at the pumping station, or say two pounds of coal a horse power per hour, then the 210-horse power saved represents five tons of coal a day. This coal, at say $3 a ton, represents $9,475 a year, which would pay five per cent. interest upon $109,500. Even if it should not be desirable to install an electric plant at the pumping station, power could likely be obtained from street railways or lighting plants already in existence in many cities. When we consider the inconvenience and cost of sometimes providing mains for difficult districts, simply to convey the water supply from a central high service pumping station, the possibility of a small electric station for each district begins to hint at the economy in first cost and maintenance of such a system.

The method of switching on and off the electric current by means of the water level or pressure is one of the details that will occur to the hydro-electrical engineer. In using this term, hydro-electrical engineer, I simply follow the tendency to specialize which has taken strong hold upon modern science and practice. At the start the hydraulic engineer thought there was nothing to do but harness the electric dynamo and motor to a pump, and the task of pumping by electricity was accomplished. The electric engineer imagined there was nothing to do but harness a pump to his motor, and behold the result was obtained. But after a few attempts, it was discovered that the pump holding such a stubborn and inelastic element as water, was subject to inertia, shock and variable power within short limits, quite at variance with the steady and uniform operation, desirable for the best electrical results. The pump man turned his attention to securing a steadier flow of water, while the electrical man was apparently inclined to adopt the convenient but wasteful methods involved in the process of wasting power instead of controlling it. Hence the hydro-electrical engineer, whose office is to reconcile the extremes of the case to the most benefit to all concerned, precisely the same in effect as the modern steam pumping-engine designer, has evolved a machine which operated by a highly elastic fluid at one end, smoothly delivers an obstinate, unyielding fluid at the other. If the steam pumping engine, taking steam from the boiler at a pressure of 150 pounds, and sending this steam to the condenser at a pressure eight pounds below the atmosphere, can deliver without shock, and with a fairly close approach to theoretical economy, a steady stream of water, there is every reason to believe that the hydro-electrical engineer will eventually be able to bring the items of short circuiting resistances, amperes, volts, etc., into a reasonably close approximation to the results demanded.

The point in the subject now reached is a very good one from which to view the future possibilities in using electrical energy upon a large scale for pumping water. The pump portion of the machine may be said to be in sight. Even now on short notice we can produce a pumping machine complete up to the binding posts for receiving the wires, and of as large capacity as has yet been produced in the steam machine. But who will step forward and furnish us with the current at a cost that will compete with the wasteful use of heat involved in the steam engine? Apparently the steam machine has nearly reached its limit, and unless some method can be discovered for utilizing the latent heat put into the steam, from under the boiler, and discharged and sent to the sewer from the condenser the remaining margin of saving is small indeed. More perfect workmanship to stop the leaks and utilize waste is seemingly all that is left for the steam engine, and the coming dawn of producing an electric current directly from combustion, or some equivalent in chemistry, seems to be even nearer than getting the use of latent heat. They may both mean the same thing. Observe how nearly we are all hovering about the secret so jealously guarded by nature. Combustion of coal under the boiler is the chemical combination of carbon and oxygen, producing in perfect combustion, carbonic acid gas. This combustion evolving the heat by which steam is made and from which dynamic energy is produced. Observe also, that the combustion of sulphur is the combination of sulphur and oxygen, the result of which is sulphurous acid gas. This in turn combined with water and oxygen produces sulphuric acid. Now diluted sulphuric acid acting upon zinc will produce an electric current directly and without the intervention of any machinery whatever, simply decomposing the zinc, a species of combustion. We all know how the storage battery will take the current from a dynamo driven by a steam engine, and apparently, reversing the sulphuric acid process, produces a storage of electrical force to be given out again under suitable conditions, producing the same product given out by the steam engine, viz.: power or energy. The decomposition of the zinc by diluted sulphuric acid produces this same effect of power by discharging the current into an electric dynamo or motor.

When will the connecting link among these various combinations be discovered, and the current be developed cheaply directly by chemical means? In the steam engine the water in the steam plays no chemical part at all; it simply acts as a vehicle for conveying this mysterious element we call heat, to a place where it can be put under conditions for the development of energy. We cannot tell by the sense of feeling when taking hold of a wire, whether it is heated by what we call heat, or by the resistance to a current of electricity. We have a fire under a steam boiler, and from it a steam engine gives out energy or power. The engine drives a dynamo, the current from the dynamo is conducted a mile or more by means of a copper wire and at the end of the wire is an arc lamp producing light by the consumption of its carbons. At both ends of this system we have combustion of carbon accompanied by heat and light, while in between we have several effects into which the unknown force is convertible. An arc lamp would burn just as well, and in fact just the same, from a current of electricity produced from sulphuric acid; in which case we should have sulphur and oxygen acting at one end of the system, and carbon and oxygen acting at the other end. When will the man arise who will pry out the hidden secret and turn the vital current directly into the binding posts of our pumping machine now ready and waiting for him? From the history of the development of the steam engine, I do not imagine that a sudden discovery will be made, but rather that the coming method will be one of gradual development; possibly and probably more rapid than that of steam, but still not by the flash of inspiration.

I leave the subject, here, at the threshold simply because I can go no further, and hope that when the new era has fully dawned, we shall all be here to appreciate and take advantage of it. In the meantime as we go on from triple to quadruple, and so on up to octuple and above, in steam expansion, the increased cost of refined work, combined with more complicated machinery, will finally bring the interest and maintenance accounts up to a point at which we may discard coal and begin to buy zinc, sulphuric acid, etc. This point may be reached sooner than we expect when it is considered that a large proportion of the coal is wasted by utilizing only seventy-five per cent. of heat of combustion at the the boiler, and then throwing away in the exhaust steam, the large majority represented by the latent heat. Opposed to this is the electric engine utilizing ninety per cent. of the zinc and producing in force directly from the first operation. When the price of zinc and sulphur approaches the combined coal and interest account, the gradual development of the electro-hydraulic engine may have commenced. A peep into the future may disclose the combination of sulphur, and the action of sulphuric acid gas directly upon some substance not now thought of in producing the electric current, or, in the coming evolution, we may deal with new elements or new combinations entirely. Edison, Tesla and other experimenters even now may have the road roughed out, and only need to seek the means of working it down to commercial smoothness.

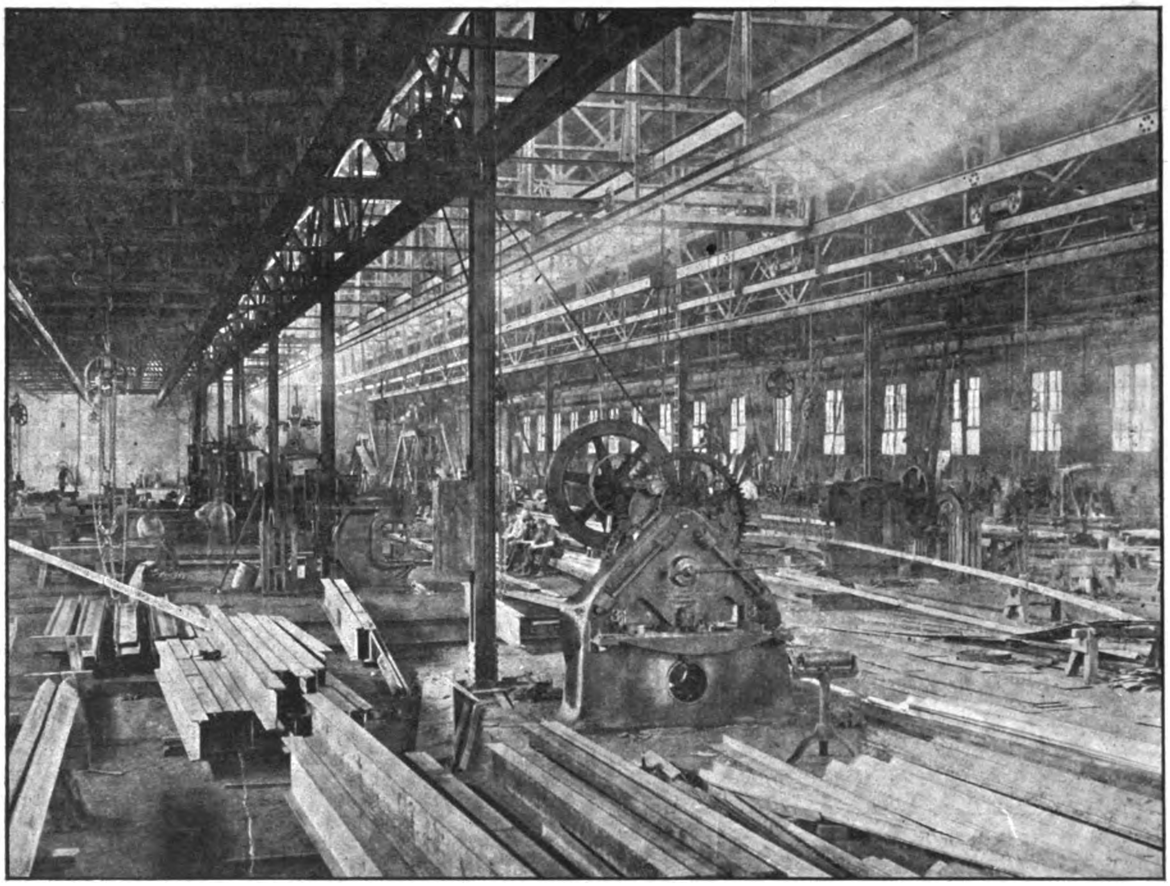
MUNICIPAL LIGHTING AT SPRINGFIELD, ILL.

"More, Better and Cheaper Light" was the motto on a handsome programme for the opening "ceremonies" of the Springfield, Ills., municipal plant, which took place on the evening of the first inst. Genl. Manager Perry of the Standard Electric Company and Mr. W. T. McCasky were in attendance to see that everything started off right. After an address by Mayor Woodruff, followed by some patriotic strains of a brass band, Mrs. Marion N. Woodruff "touched the button" and instantly the large standard arc machines sent current to the city's street lamps, signalling the starting of another municipal lighting plant which is expected to make money for the city. Everything started in good shape without a hitch of any kind and the Standard Electric Company is to be congratulated on the successful start.

THE JENNEY ELECTRIC MOTOR CO.'S RECENT WORK.

The new shops of the Jenney Electric Motor Co., situated on the Belt railroad, Indianapolis, are now rapidly nearing completion, and when finished will be able to handle the largest sizes of generators and motors. In their new quarters the company will have a capacity four times as great as their present. The Jenney Co. has been devoting special attention to motor work of late, and among their installations is the equipment of the shops of the Brown-Ketcham Iron Works, at Indianapolis, the machinery in which is driven entirely by electric motors.

The Brown-Ketcham Co. manufacture structural iron work for buildings and bridges, and frequently handle pieces weighing from 20,000 to 80,000 pounds, the average yearly output being from 8 to 12 million pounds. The main shop, illustrated in the accompanying engraving, is 370 ft. long by 97 ft. wide, and is fitted with heavy machinery, very much scattered on account of the bulky character of much of the work done. The following is a partial list of machines in operation: A heavy shear, capable of cutting off a 6" x 6" x 1" angle iron, operated by a seven and one-half horse-power motor directly belted to the fly wheel. A heavy plate shear similarly driven. Six punches capable of punching a 1½" hole in ¾" steel, each run by a three horse-power motor. A double-headed rotary planer capable of facing off the ends of a column 2' 6" in diameter and 34' long. A short shaft, operated by a ten horse-power motor, runs several lathes and shapers, seven machines in all. A ten horse-power motor on a Sturtevant blower, consuming fourteen horse-power during ten hours' run.



JENNEY MOTORS IN THE SHOPS OF THE BROWN-KETCHAM IRON WORKS, INDIANAPOLIS.

In addition to the above there is a 15,000-pound traveling crane, traversed by a three horse-power motor.

The maximum power taken by these machines was thirty-five horse-power, as indicated by the electrical meters in the power room. This low consumption of power is, of course, accounted for by the fact that all machines do not run at maximum power at the same time.

In an old and smaller building, burned and replaced by the present structure, shafting, gears, countershafts, quarter-turn belts and hangers were used, and when a machine was shifted in position a re-alignment of shafting often became necessary.

Records kept over a sufficiently extended period of time show that the cost of power for operating the shops by electric motors is one-sixth of that formerly required with steam power with main and counter shafts.

BURRELLE'S PRESS CLIPPING BUREAU.

ALTHOUGH the press clipping bureau is a modern offshoot of newspaper work, it has already come to be recognized as an indispensable means of securing special information. Time is daily becoming more valuable to the business man, and he finds that it pays him better to buy what he wants to know from a press clipping bureau, than to waste his office hours in hunting for it himself. The Press Clipping Bureau established by Frank A. Burrelle, at 131 Western Union Building, New York, with branch offices in Washington and Chicago, has for the last six years been steadily gaining ground, and the business has now reached such proportions that Mr. Burrelle has found it advisable to associate with him a partner of the same energetic and progressive character as himself. Mr. Richard L. Weithas, who now joins the Bureau is well known among electrical men. He has been for many years creditably connected with electrical journalism, and he brings to his new task, not only the good wishes of a host of friends, but also a record for industry and integrity which cannot fail to be a valuable help in the congenial field to which he has now turned his attention. In the hands of two such men as Messrs. Burrelle and Weithas, the Burrelle Press Clipping Bureau should rapidly extend its borders, and secure in the future an increasing share of the success it has so deservedly attained in the past.

NEW ORDERS FOR BALL ENGINES.

The Mount Washington Light & Power Co., Hollins, Md., has lately installed a "Ball" engine, built by the Ball Engine Co., Erie, Pa.

The new Juvenile Female Offenders Home at Geneva, Ill., has just started up the electric light plant. A "Ball" engine, built by the Ball Engine Co., direct connected to C. & C. electric dynamo, furnishes the light.

The Catholic University, Washington, D. C., has lately put in an electric light plant. The two engines supplying the power are "Ball" engines.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

LUNDELL ELECTRIC ORGAN BLOWING MOTORS.

THE Interior Conduit and Insulation Co. have just placed on the market a new line of organ blowing motors for reed or pipe organs, to operate on direct current at 110, 230 or 500 volts. As will be seen from the accompanying illustration, these outfits are

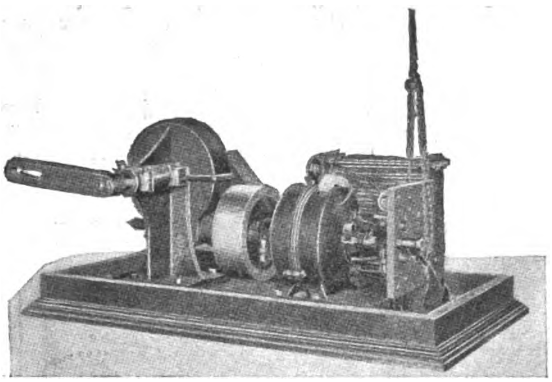


FIG. 1.—LUNDELL ORGAN MOTOR OUTFIT.

to be directly connected to the wheel, handle or shaft of the bellows, thus doing away with expensive belting, shafting, and other cumbersome accessories which, of necessity, have heretofore been used in conjunction with electric organ blowing motors. The outfit, occupying but a small space at the side of the organ, may be hidden by a screen or inclosed in a box of suitable design. The box for the ¼ h. p. size is 32 inches long, 18 inches high and 17 inches wide. These outfits, which are made up to 5 h. p., are noiseless, and the bellows of the organ is always under

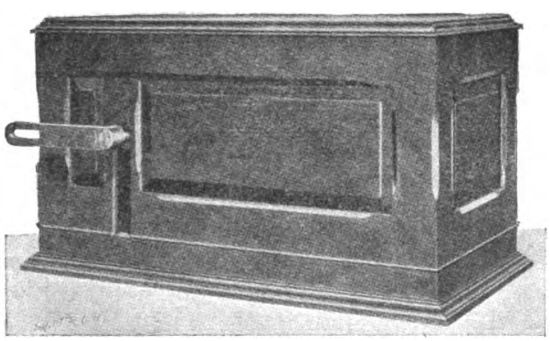


FIG. 2.—ENCLOSING BOX FOR LUNDELL ORGAN OUTFIT.

absolute control. Under average playing conditions the motor maintains almost a constant speed, keeping the bellows nearly full. When the entire resources of the organ are drawn upon, the motor quickly speeds up, giving the maximum supply of wind. If the player suddenly stops or plays pianissimo, the motor immediately responds, and its speed is decreased, so that the bellows is not over-blown, the outfit completely controlling the wind supply under any and all conditions.

NEW INSTALLATIONS OF BALL ENGINES.

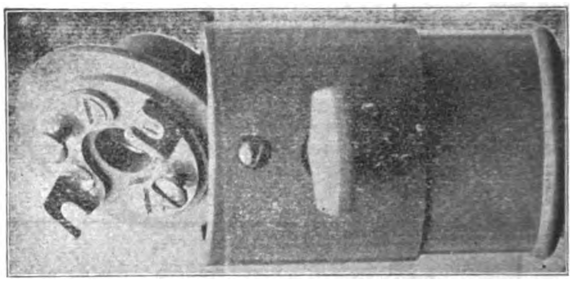
The National Bank of Commerce, Pittsburgh, which is now being built will have an electric light plant. "Ball" engines, built by the Ball Engine Co., Erie, Pa., direct connected to C & C electric machines, will furnish the light.

The Edison Light & Power Co., La Crosse, Wis., are making some improvements in their plant. They have purchased a 225 H. P. "Ball" engine, built by the Ball Engine Co., which will be direct connected to two General Electric dynamos, one on each side of the engine.

The new Tradesmen's Bank Building of Pittsburg, Pa., will have quite a large electric light plant. Three "Ball" engines, built by the Ball Engine Co., direct connected to Westinghouse dynamos, furnish the power and light.

THE BALSLEY & BRYNER NON-CONDUCTING SOCKETS.

Balsley & Bryner, of Connellsville, Pa., have put upon the market a form of lamp socket which has long been needed. Its specialty is that it is made of non-conducting material, and the advantage of this construction is supplemented by the ornamental appearance of the socket. Its shell, which is made of Electrose, highly polished, consists of two parts. To the base are attached two brass ears, to which the terminals of the conductors are fastened by binding screws. Projections from the ears engage



THE BALSLEY NON-CONDUCTING SOCKET.

with lugs in the body of the socket when the cap is in place. The conducting parts are entirely protected from contact with external objects. As the shell is of non-conducting material, a short circuit from one conductor to the shell, a common occurrence with brass shell sockets, is impossible. The wiring is admirably simple. The base is removed, the conductors are placed under the binding screws, and fastened down with a screwdriver. The socket is suitable for use in all kinds of both interior and exposed work. It is made in any color, so as to harmonize with the fixtures to which it is attached.

JOS. DIXON CRUCIBLE COMPANY'S GRAPHITE PAINT.

TWENTY-FIVE or thirty years ago the Dixon Company of Jersey City, N. J., who even at that time were known the world over as the largest manufacturers of graphite products, began the manufacture and introduction of graphite paint. Ticonderoga flake graphite was used and thoroughly ground in pure, boiled linseed oil. Roofs well painted with this paint did not require repainting for 10 to 15 or even 20 years. In time all this became a matter of record, and people recognizing the economy, as well as the durability of Dixon's graphite paint and its great superiority demanded that their roofs should be painted with it. This demand, however, has led many painters to make a so-called graphite paint which they claim to be equal to Dixon's, and which, having the color of graphite, is composed of stove-polish, cheap black lead, or even foundry facings, mixed with oil. Other painters, honest in their intentions, but ignorant that there is a vast difference in graphite, have used ordinary commercial black lead, ground with oil, expecting it would meet the requirements of their customers and prove as lasting as the genuine Dixon graphite paint. So wide, however, is the difference in results, that experienced buyers insist on seeing the label on the package, or buy the paint themselves and have the painter apply it. Some time ago one of the departments of the U. S. Navy ordered 100 lbs. of Dixon's graphite paint of a well-known dealer. The dealer, not having that quantity on hand in an original package, filled a keg from a barrel of Dixon's paint and sent it forward. It was promptly returned by the Government officials with the remark, that they had experimented enough with other makes and would only receive original packages. An experience covering a quarter of a century and over, has demonstrated that the peculiar flake graphite, mined at Ticonderoga, gives the best results. When the paint is brushed out each flake laps over its fellow, after the manner of fine fish scales forming a covering of great elasticity and durability.

"CHLORIDE SURGICAL BATTERIES."

MR. JAMES G. BIDDLE, Drexel Building, Philadelphia, as special agent of The Electric Storage Battery Company, has recently brought out a complete line of "Chloride Surgical Batteries," which promise to meet the requirements of the medical profession in a most satisfactory manner. The "Chloride Accumulator" is said to have a greater ampere capacity per pound of element than any other storage battery, and this fact, coupled with freedom from buckling, renders it desirable for cautery or diagnostic work. The lead plates are contained in sealed hard

rubber cells, which in turn are handsomely mounted in mahogany cases with rheostats, pilot lamps, commutators, etc. Mr. Biddle is arranging with prominent houses throughout the country to handle these outfits, so that doctors, hospitals and medical colleges can obtain them through local dealers in any large city. Descriptive circular 110 should be written for by interested parties. As selling agent, Mr. Biddle also is in position to name lowest prices for "Chloride Accumulators" of any size and for any purpose; devoting particular attention to equipments for college and experimental laboratories.

METROPOLITAN ELECTRIC CO.

The Metropolitan Electric Company, Chicago, have received their first installment of Ayer arc lamp windlasses. This windlass is very simple in construction and is one of the strongest and most convenient on the market. It is sleet proof, having a hood that covers the cable. It is self locking and makes a very neat appearance. It will pay central station managers to investigate the merits of the Ayer windlass before placing their orders.

The Metropolitan Company report the demand for their Metropolitan incandescent lamp to be on the increase. The reason for this is that the central station manager who operates his plant without the use of meters finds it economical, and the consumer, using light furnished by a station on the meter system finds his bills much smaller at the end of each month.

The hot weather has given a sharp impetus to the fan business, and the Metropolitan Company are supplying the demand as best they can with their celebrated Dayton ceiling fan, Victor direct current desk fan and Ries and Scott alternating fan.

The Metropolitan Co. will soon be out with their new catalogue, which will be, it is asserted, the best and most complete ever made.

NEW THREE-PHASE INSTALLATIONS OF THE GENERAL ELECTRIC CO.

An interesting power transmission plant is in course of installation at Bayonne, N. J., where the three-phase system of the General Electric Company will be employed to operate the machinery of the Tide Water Oil Company. This company is one of the Standard Oil Company's interests and is engaged in exporting the refined products of petroleum. The nature of the process is such that spark proof apparatus is an imperative necessity and multiphase apparatus was selected as the only machinery which could meet the peculiar conditions.

The generator will be a 550 volt three-phase General Electric machine having eight poles and a capacity of 75 kilowatt. The several induction motors will be of five, ten and fifteen horse power. Some of these are spark proof, and have a permanent resistance in the armature circuit. A special interest attaches to these, as they will be employed in places where there exists an ever present danger of explosion from gases, which a spark could readily ignite. They will be used to operate pumps, elevators and other machinery. The switches will be of special construction, their blades immersed in oil.

The generator also supplies current for about 525 lights scattered throughout the different parts of the works. Regulation of the lighting circuits will be effected by special revolving regulators of novel design.

The Oakland Gas and Electric Company, of Oakland, Cal., will also use a three-phase transmission plant for general power work. Current to a number of induction motors ranging from one to fifteen horse-power will be supplied from a 75 kilowatt three-phase machine and there will be extensive lighting in connection with the plant. The generator current at 2,000 volts will be reduced at two centres of distribution to the necessary potential and the secondary net work will cover a territory of 1,200 feet in every direction from both centres. From these points pressure wires will be run back to the power house, and the voltage will be there controlled by potential regulators.

A plan somewhat similar will be followed by the Fall River Electric Company, of Fall River, Mass., but instead of three-phase, monocyclic apparatus will be used. Two 75 K. w. generators will be used and the output will be used for lighting purposes, during the dark hours, supplying current during the day for general power work. The motors will be of the General Electric induction type ranging from one to ten horse-power and will be wound for 110 volts, to which pressure the current generated at 2,000 volts will be reduced.

DENVER ENGINEERING WORKS CO.

Messrs. Shepard & Searing, mechanical and electrical engineers, of Denver, Colorado, in conjunction with Mr. William J. Miller, formerly owner of the Miller Forge Company, of Pittsburgh, Pa., have purchased the entire machine shops and foundry of The Overland Machinery Company, of Denver, and have incorporated The Denver Engineering Works Company. They will manufacture mining, milling and smelting machinery, and take contracts to design and erect complete mining, steam and electric plants. They will give especial attention to the electrical transmission of power as applied to mines and smelters, in which they have had considerable experience. The officers of the Company are: President, William T. Miller; Vice-President, Frank E. Shepard; Secretary and Treasurer, Lewis Searing. The board of directors contains some of the best men of Denver: Henry R. Wolcott, President, The Denver Equitable Company; Julian A. Kebler, General Manager, The Colorado Fuel and Iron Company; John L. Jerome, Treasurer, Overland Cotton Mills; and H. H. Dunham, of Wolcott & Vaile. The Denver Engineering Works Company will soon be in the market to buy iron and steel, machine tools and machinery supplies.

MICHIGAN PIPE CO.'S CREOSOTED WOOD CONDUITS.

The ordinance recently passed by the council of the city of Pittsburg requiring all the telegraph, telephone and electrical companies to bury one eighth of their overhead wires, within certain districts, each year for the next eight years indicates the advance which the cry "Down with the wires" has made.

The expense entailed by the various companies to satisfy this demand has put a double problem upon their managers; first in asking them to pay dividends upon stock from fixed rates, while increasing the expenditures; and second to find a permanent material from which to construct their conduits. Probably no company in the country has made a more careful investigation of the adaptability of materials for conduits than the parent Bell Telephone Company, and their indorsement of creosoted wood for conduits is the result of patient thorough work, and to-day it stands in the highest favor. It is certainly a compliment to the judgment of the gentlemen in Brooklyn and Philadelphia who were pioneers in underground work that this company chose creosoted wood for their subways at the start, and to-day they find it in perfect condition and endorsed by eminent engineers after years of careful study.

The demand for creosoted wood conduits has become so great that through it a new industry has been called into existence in preparing it. There has been a practice of small shops doing part of the wood work and shipping to the sea shore to some creosoting plants there to have the tubing treated, and then reshipped to the consumers. At Bay City, Michigan, The Michigan Pipe Co., have recently arranged their plant to have all of this work done under its own roof, by putting in special machinery for doing the wood work and a large heavy cylinder with connecting boilers and pumps for treating conduits with the dead oil of coal tar, which is claimed to be the finest plant of the kind in existence. The making of wood pipe is not a new business to this Michigan Company as they are the largest manufacturers of Wyckoff (wooden) water pipe, and square pipe for tanners, chain pump tubing, etc. on the continent, and have added the creosoting plant as a new department. Surrounded by the finest forests of pine they are in position to supply the trade not only with accurately machined tubing but with the best materials obtainable.

A DETROIT TROLLEY COMPANY PRESENTS "LALLA ROOKH."

Something novel in the way of a street railway opening is to be given by the Detroit Railway. The company have arranged to present Pain's mammoth pyro-spectacle of Tom Moore's "Lalla Rookh," in a park which has been purchased by the company, located in the northwestern part of the city on the line of railway, and which will be known as Boulevard Park. This is the opening festival of the new company, and preparations are already being made for it. The tract of land to be used is 750 feet long by 350 wide. The grand stand is to be 300 by 100 feet. The entire exhibition grounds will be surrounded by a twelve-foot fence. A large lake, 250 by 60 feet, will be dug in front of the grand stand, with a depth of from six inches to six feet. In front of this will be the stage, which is to be 100 by 50 feet. The dressing and costume rooms will be 90 by 16 feet. Then there will be three property rooms, and a fire proof brick building 16 by 12 feet.

The production will cost $25,000, and will be given for ten days, beginning July 25. 500 people will be employed in its presentation, and there will be a band of fifty pieces. The railroad companies will make excursion rates during the time of the spectacle from all parts of the state. The affair is intended to be the most gorgeous thing ever attempted in Detroit and the railway company is going to spare no expense in making it a success. Electricity is to play a considerable part in the work, it is said.

BIDS WANTED FOR ELECTRIC ELEVATORS IN WASHINGTON.

The Treasury Department, Washington, through the Supervising Architect's Office is inviting proposals until June 18, for furnishing one electric passenger elevator and one electric freight elevator for the Treasury Department. Prospective bidders can obtain additional information by addressing Hon. Wm. Aiken, Supervising Architect, Treasury Department.

MESTON MOTORS.

The Emerson Electric Mfg. Co. of 1108-1110 St. Charles street, St. Louis, Mo., have issued a very handsome new catalogue, in oblong form, devoted to their alternating current motors. All their specialties are well illustrated, with supplementary details as to price, size, etc. The Company build for both high and low alternation, and have a large stock always ready for shipment, of 16,000 and 7,200 alternations respectively. The catalogue shows the Emerson induction fan motor, without commutator, and their other regular types for desk or stand; their ceiling fan motor; sewing machine motor; dental motor; "3 inch" motor for small lathes, buffers, etc.; slow speed alternating motors single or duplex, being a special geared adaptation of the ⅛ H.P. This ingenious device is made either with single motor, or duplex, with two, in which case both motors are mounted on one base and geared to a single countershaft. The catalogue concludes with data about the ceiling fan and instructions for mounting and operating it.

WESTERN NOTES.

MR. GEO. E. FISHER who is so successfully handling the Standard apparatus in Michigan, was a Chicago visitor last week.

MR. J. F. GILLILAND of the Gilliland Telephone Company, Adrian, Mich., ran down to Chicago for a few days last week to enjoy the summer resort climate and incidentally to talk over some business matters with President McKinlock.

MR. W. C. MCKINLOCK, the secretary of the Metropolitan Electric Company, Chicago, has just returned from a southern business trip. He secured some profitable orders, and reports a decided improvement in business.

THE WESTERN SOCIETY OF ENGINEERS will extend the courtesy of one of their rooms to Lehigh University on June 21st, 22d and 23d, in which to hold its local examinations to the freshman class. The examinations will be under the direction of Mr. H. F. J. Porter, Western representative of the Bethlehem Iron Co.

MR. JAS. WOLFF the energetic representative of the New York Insulated Wire Company is now nicely settled in his new quarters 320 Dearborn street, Chicago. Being nearer the electrical business centre and with better facilities for carrying a large stock of the company's products, Mr. Wolff will find it somewhat easier to serve his constantly increasing line of customers.

THE CINCINNATI EDISON COMPANY have just placed an order for four more 80 light Standard arc dynamos and Standard lamps. After the severe tests given the thirty two, 50 light Standard arc machines previously purchased, and the remarkable record made by the machines in the matter of no repairs to speak of, it must certainly be gratifying to the Standard Electric Company to receive so plain a proof of the advisability of using their apparatus.

THE METROPOLITAN ELECTRIC COMPANY, 186–188 Fifth Avenue, Chicago, has secured an order for their "Portable Fire Hose Bridge" from the Chicago Transit Company, who, recognizing the merits of this device, have decided to equip their lines with them. The Metropolitan Electric Company also report a good demand for their various first-class specialties, such as the P. & B. products, Solar arc lamps, N. I. R. wire, Dayton ceiling fans, Keystone instruments, etc.

THE ELECTRIC APPLIANCE COMPANY are doing a nice business in Jaeger miniature lamps, for which they have just taken the General Western Agency. The complete line of Jaeger goods includes mounted and unmounted series lamps, battery lamps, dental lamps, theatrical lamps, lamp bases, shades and holders. The Electric Appliance Company carry a complete line of these goods in stock in Chicago, and is prepared to quote special figures on quantity orders. They have a special catalogue of these goods, which they will be pleased to furnish on application.

STANDARD ELECTRIC CO.—Many municipalities have determined to pay a lower rate for street lighting during the coming fiscal year, and where the local lighting company has refused to accept the lessened price, the question of municipal ownership is being agitated. Naturally the central station manager is in a quandry. How best can this problem be solved is the question of the hour. The solution offered by Mr. E. E. Crepin of the Standard Electric Company of Chicago, is certainly worthy of thoughtful consideration. A saving in operating expenses of 2 per cent. per lamp per night, aggregates quite a sum in the course of a year, and this saving judiciously handled will enable a better financial showing to be made even though a smaller price for street lighting is accepted.

THE ELECTROZONE COMPANY of New York city has been formed to manufacture disinfectants and deodorizers for the purification of water and sewage, and for the treatment of garbage. Capital, $500,000. Directors, Adolphus Bonzano, Albert E. Woolf, and John A. Barham of New York city.

NEW YORK NOTES.

MR. HARRY BARRINGER COX, whose improved thermo-electric generator, recently described in THE ELECTRICAL ENGINEER attracted so much attention, has sailed for Europe on business.

THE ELECTRIC LAUNCH CO., of Morris Dock, N. Y., reports an excellent business this summer, with orders and inquiries from all quarters.

THE NEW STEAMER "ST. LOUIS" sailed away for England last week, and the most resplendent part of all her equipment as she left New York was her installation of 3,000 or 4,000 beautiful, glistening Buckeye lamps.

MR. W. E. SHELDON, treasurer of the Fitchburg Engine Co. was in New York last week, closing up some new contracts for engines. The company find trade to be improving generally, and have of late been very busy in connection with engines for municipal lighting plants in New England.

THE THIRD AVENUE RAILROAD CO. has obtained from the Board of Aldermen, in competition with the Metropolitan Traction Co. important franchise privileges through Kingsbridge and the annexed district, and will build forthwith. A large slice of trolley work is expected.

J. A. MACHADO, Electrical Machinery, 203 Broadway, New York, has become the New York manager of the Louisville Electrical Works, of Louisville, Ky., and has added their excellent and very complete line of transformers to the other well known and standard goods which he is selling. Mr. Machado reports increased inquiries and orders for Triumph motors, Hill switches, Whitney instruments and other specialties.

MR. E. J. WESSELS of the Standard Air Brake Co., has just got in from a successful trip through the State, and reports things to be all coming his way—in spite of the fact that he is putting the brakes on! Never before was the desirability of a good brake so fully appreciated in street railway circles, and the company is beginning to enjoy the reward of energetic management and shrewd advertising.

HON. GARDINER C. SIMS, of the Armington & Sims Engine Co., during a recent visit to New York and while calling at the ENGINEER office reported things much brighter throughout New England, and the mills around Providence to be quite active again. The demand for first-class engines is excellent, and Mr. Sims reports a growing reversion of central station men to high speeds, as against the low speed types that have of late been dominant; it being found, he says, that the low speeds do not and cannot give steady, unflickering light.

PATERSON, N. J.—The new equipment of the Edison Electric Illuminating Company of Paterson will include a number of engines, which together form one of the largest contracts in this line which have been given out certainly for some years, and the Ball & Wood Co. of New York are to be congratulated upon receiving this order. The equipment will consist of five of their new type of vertical engine, 600 H. P. each, two of the same type of 700 H. P. each, and one of 300 H. P. This station is expected to be a model one in all respects, and for many months the officers of the Company have been gradually working up the details and investigating appliances.

NEW ENGLAND NOTES.

THE NORWALK TRAMWAY CO., of Norwalk, Conn., have placed the order with The Berlin Iron Bridge Co., of East Berlin, Conn. for a car barn 45 ft. in width and 160 ft. in length, constructed entirely of iron.

NEW BRITAIN, CONN. The contract for the steel bridges for the Central Railway & Electric Co., of New Britain, Conn. for their various extensions has been placed with The Berlin Iron Bridge Co.

THE WHITNEY ELECTRICAL INSTRUMENT CO., of Penacook, N. H., have opened an office at 126 Erie County Bank Building, Buffalo, with Mr. Frank C. Perkins in charge. They will carry there a full line of their standard instruments in stock so that the trade throughout that section can be promptly supplied.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have just completed a new boiler house roof for the Stanley Works, at New Britain, Conn. They are also the engineers and architects for the large three-story building which the Union Metallic Cartridge Co. are now putting up, at Bridgeport, Conn. The entire framework of the building will be steel, with brick walls, and all appliances for making the construction as nearly fireproof as possible.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

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REIS'S PLACE IN TELEPHONY.

BY

A. E. Dolbear

IN the German Exhibit at the World's Fair at Chicago was displayed a bust of Phillipp Reis, of Friederichsdorf, Germany, and it was labeled with a card stating that he was the inventor of the electric speaking telephone. A monument built by the German people in his memory bears the same statement as an inscription. Reis's work on the telephone was all done between 1860 and 1863, yet in this country we have heard of him chiefly for what it has been alleged he did not do. Within a year or two it has been written in good English by persons who certainly ought to know, that Reis's telephone was only a tone telephone which would reproduce sounds of various sorts but not speech, and this in spite of the fact that Reis said emphatically in one of his lectures that "words even were reproduced" by his apparatus, and in spite of the explicit testimony of a good number of persons yet living who were witnesses of his work in his own hands that they heard it transmit speech, such for instance as Prof. Quincke of Heidelberg, Dr. Messel of London, Dr. Hagen of Cambridge, Mass., now deceased. The question is not as to whether the speech was transmitted well or ill, but was it transmitted at all. If it was transmitted at all then he was the inventor of the telephone. Improvements might come but the apparatus to be improved was already invented. Henceforth it was simply a question of relative efficiency.

After improvements in both transmitter and receiver had been made and the telephone became of commercial importance the owners of the improvements saw that to hold a monopoly on the business it was needful to show that Reis did not invent a speaking telephone, and to accomplish this, technical advantage was taken of every available thing. Reis's description of his apparatus was strained beyond measure, his plain statements were ignored, the direct testimony of eye and ear witnesses was not allowed to be heard and as Reis himself was dead he could not be heard. Worse than that, inventors were allowed to patent apparatus which embodied what Reis showed in his, without any improvement, if the description of it and its mode of operation was different from Reis's. As proof of this, compare the apparatus described in the famous Berliner patent about which there is now so much concern, —a patent which was applied for in 1877, and issued in 1891. There is not an essential thing in that which was not shown in Reis's devices and for the purposes of speech transmission the latter will work as well as the former; but they are described in terms which will apply equally well to Reis. Now a change in description of a piece of apparatus does not make a change in its mode of operation. The latter is automatic. That which makes the transmitter of to-day better than the Reis transmitter is the substitution of hard carbon, and *nothing else*, in the same place and for the same purpose for platinum which was used by Reis. If Reis had chanced to employ such carbon in the place of platinum he would have had a good speaking telephone and he might have described its mode of operation just as he did describe his platinum tipped electrodes.

The whole stress of the controversy was not upon the apparatus and its necessary automatic action, but upon Reis's description of its mode of operation, and so successful was this attempt that one judge declared that "a century of Reis would not make a speaking telephone." This can only refer to the description, not to the apparatus, for, as I have said above, the substitution of a bit of hard carbon for the platinum terminal would have made a perfect transmitter.

Who made that substitution? Neither Bell, nor Blake, nor Berliner, nor Edison, but Hughes of London, and he gave it to the world. Like many another testamentary gift the legatee failed to receive the legacy through crafty legality.

Again, in 1866, Mr. Yates, of Dublin University, while experimenting with Reis apparatus placed a drop of water between the terminals of the transmitter for the express purpose of preventing the abrupt breaks in the current, and succeeded in transmitting speech perfectly as one can see would be the case. There were several witnesses of this living when the telephone cases were being heard here and abroad, but their testimony was excluded. Nothing would answer but the printed page, printed at the time; and as it happened the experiment was not described, only remembered, it followed that what was good enough for true history was not good enough for law.

Once more. Emphasis has been put upon the statement that the inefficiency of the Reis transmitter is due to its breaking the current at every vibration so it can only transmit pitch and not speech, whereas it is easy to show it is nothing of the sort, and that when the transmitter is spoken to gently it transmits fairly well, in spite of the breaks which may occur. Sudden breaks in the current make so strong a sound in the receiver of any type as to persist in the ear for an interval long enough to drown weaker sounds if they be present. If the Reis transmitter be provided with a shunt circuit, so there will be a current in the receiver all the time whether the movable terminals be in contact or not, one may discover at once whether the apparatus works the way it has been alleged to work and as the courts have decided it does work. One may hear and understand nearly everything said, and this proves that the Reis transmitter has the proper microphonic action. This does not make it a commercial instrument, but it serves to show that all the arguments made against it were wrong and were based upon untrue assumptions.

Many substances have been tried in the endeavor to find a substitute for hard carbon. None have been found its equal for such a purpose, but the metal osmium works fairly well, while silicon and boron, the chemical relatives of carbon, can also be used.

Some day the whole story of the telephone will be written. Distinctions will be be made where they exist and where they do not exist; identity will be noted. It is now very certain that then there will be no need to change the inscription upon Reis's monument.

NON-MAGNETIC THERMO-REGULATED APPARATUS IN PRACTICE.

BY

Will you permit the writer to say a few words concerning the practicability of regulating any or all electrical apparatus by a so called "heat movement," about which several articles have appeared recently in The Engineer.

In the issue of May 8 one writer seems confident that thermo-regulation is the "one and only," "after which we long have sought and mourned because we found it not," so to speak; and in *The Western Electrician* of June 1, the same writer describes an arc lamp of his invention, which, quoting the language he used, is "for either constant current series, alternating, or constant potential circuits, from any generator," certainly an ideal piece of lighting apparatus.

He further states that "the thermal strip gives a more perfect regulation and closer feed than an electro-magnet," and that "the variations are practically so small that the lamps may be said to burn almost without variation of E. M. F., current or candle power."

After all that has been said in the electrical journals of late concerning enclosing the arc, this enthusiastic writer before mentioned shows in his article an arc lamp with arc enclosed, and says that: "A glass tube encircles the carbons to increase the length of their life and keep down the resistance of the arc by excluding cold air."

The above statements covering perfect conditions of operation to obtain which so many of us have spent such large amounts of money certainly should not pass without comment, and deserve the criticism they are receiving at the hands of those better posted in the matter than the writer quoted seems to be.

These ideal conditions are further from realization in the operation of "heat movement" arc lamps than almost any thing else.

The present earnest and unsatisfied demand for a perfect alternating current arc lamp led the writer with others to experiment with every known kind of lamp for such a circuit and for a time the "heat movement" seemed to meet all conditions. The perfect starting of the lamp without the chattering incident to solenoid operated movements, the ridding the lamp of all noise in its operating mechanism, and the seemingly perfect feeding of the carbons were strong arguments in favor of a heat movement.

The arguments against its universal adoption only presented themselves after several hundred such lamps had actually been marketed to almost as many customers. Heat, cold, dust, steam, smoke, miscellaneous fumes, etc., soon demonstrated the commercial impracticability of the thermo-regulating wire.

We were inclined to give the new movement the benefit of the doubt and thought at first that the material construction of the regulating ribbon itself was at fault, it being German silver of ordinary commercial quality. We then tried every known alloy and finally adopted the celebrated Krupp resistance material, the best known composition for resistance and thermo-regulating purposes, but with no better results. After spending some $20,000 and three years time chasing chimerical arc lamp perfection through the medium of heat movements of all kinds we have certainly the right to say that the writer quoted is in common parlance "way off," as the existing commercial requirements are not met in any appreciable particular with the heat movement either in his apparatus which we have tested or in any one else's apparatus up to this time.

To quote from Dr. Sheldon's article in The Electrical Engineer of May 29, we can also from dear experience say that "a thermal device cannot replace a magnetic one when responsiveness is requisite" and responsiveness is more than requisite in arc lamp mechanisms; it is prerequisite, so to speak, as it must not only expand but it must needs contract and that quickly, too, but in practice outside of the laboratory it does not respond with the required sensitiveness.

The writer first quoted states that "a closed globe or tube enclosing the carbons reduces the resistance of the arc." Oh! How we all wish it did. In our laboratory enclosing the arc increases the resistance of the arc in proportion somewhat to the tightness with which the enclosure is made. We have often doubled the difference of potential at the carbon points in this way. This may not be the case in Cleveland, however, although as far as we know it is true everywhere else.

Some of us have been to that expensive school teaching that "laboratory perfection does not mean commercial success" and certainly this was never more true than in the case of thermo-regulated electrical apparatus.

THE FRENCH LACK OF SUBMARINE CABLES.

The recent and still smoldering war in the far East has aroused our French cousins to the fact that they are poorly equipped with submarine cables, and that in the event of hostilities in which they were involved themselves, every message between Paris and the East would practically have to pass through English hands or English territory. The New York-Brest cable is about the only long deep-sea cable under French control, and that would be of little use at such a juncture owing to the absence of American links from the Pacific Coast across the Pacific Ocean. There are two aggravations of a serious nature. One is that in time of war the English Government assumes active supervision and management of cable work for all the English companies, so that any French message would pass under unfriendly and suspicious eyes, and would be subject to intolerable delay. Another feature is, that in Pacific waters the English fleet is to the French as 5 to 1, so that the Franco-Chinese colonial system might be smashed to smithereens before the ministry in Paris knew it had even been attacked, and thus again would perish the fond French hopes of dominion in Asia.

The situation is, no doubt, a serious one for Frenchmen, and can only be met by an extension of cable laying for strategic purposes The subject is being discussed by the leading newspapers in France in a sober, dignified and determined manner that cannot but influence governmental action. Two or three good cables would serve as a substitute for many new ships. The arguments that are being used in France are largely applicable to our own case, as regards the East and our Pacific trade.

THE CARD MOTORS FOR TOOL DRIVING.

All modern machine shops are equipped with traveling cranes, but in most cases the full advantages to be derived from these cranes are lost, from the fact that it is impossible or very difficult and expensive to place the tools so as to be easily served by the cranes. With a direct connected motor on each large tool, the shafting is entirely dispensed with, and the tool may be placed in the most convenient place either to receive the work or to economize space. Not only can time be saved in handling the work, but the tool itself can be operated more quickly and easily.

The Card Electric Motor & Dynamo Co., of Cincinnati, has of late devoted considerable attention to the equipping of machine tools with direct connected motors. As a striking example of this class of work, we illustrate in the accompanying engraving, Fig. 1, one of their motors built in the headstock of a 42″ Niles Tool Works lathe. The motor is made upon a sleeve, which slips over the spindle in place of the ordinary cone pulleys, and in most makes of lathes takes up no more room.

The motor runs at nine different speeds in either

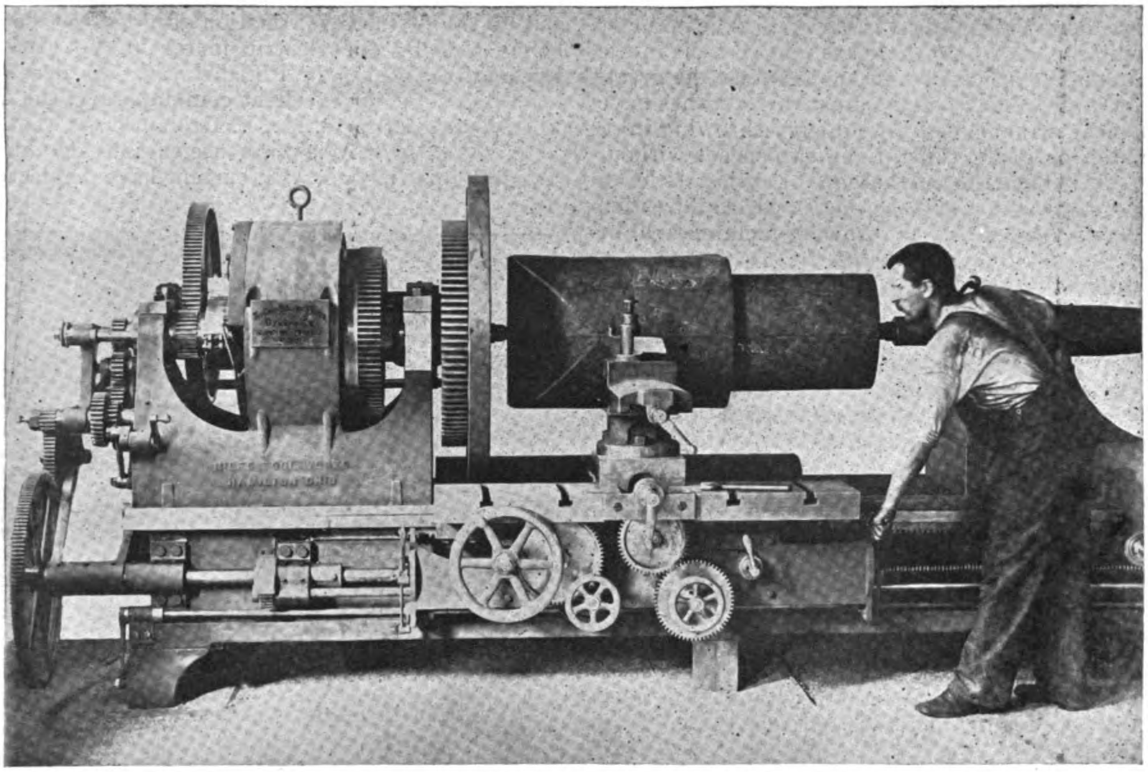


FIG. 1.—CARD ELECTRIC MOTOR DIRECT-CONNECTED TO A NILES 42-INCH LATHE.

direction, at from 57 to 275 revolutions per minute (the ordinary cone pulley runs at four or five) and the speed is controlled by a lever on either side of the apron of the car-

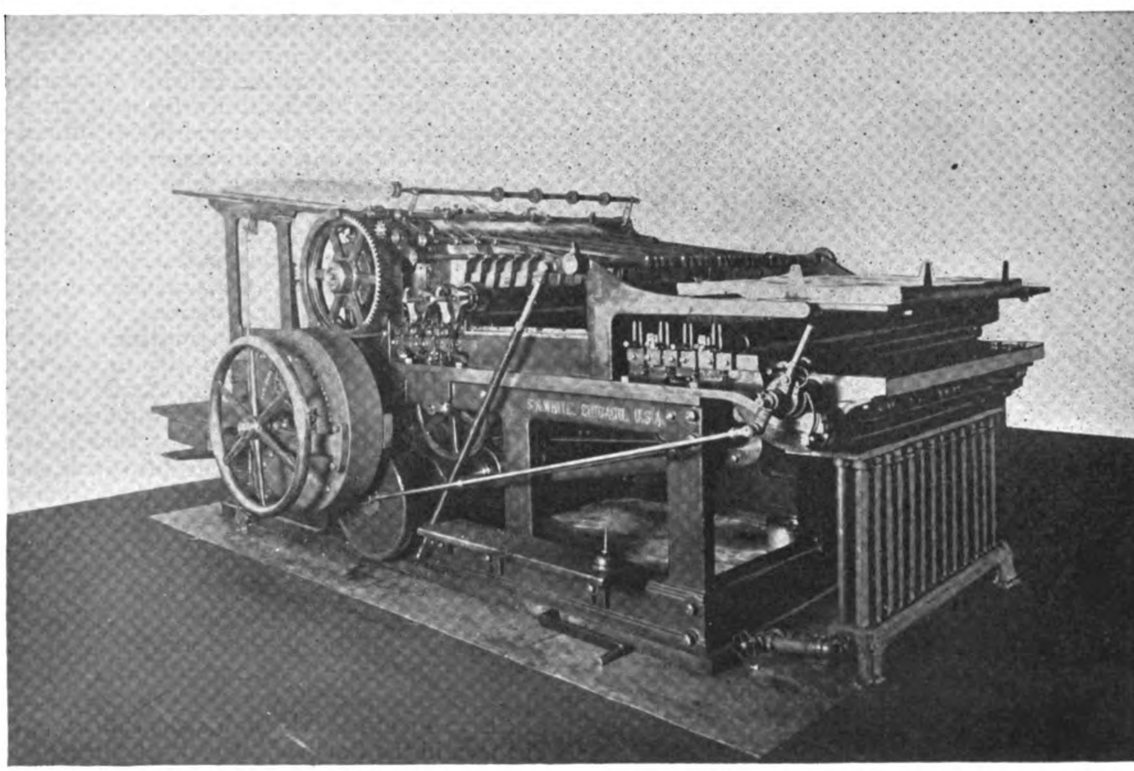


FIG. 2.—CARD ELECTRIC MOTOR DIRECT-CONNECTED TO MIEHLE PRINTING PRESS.

riage. As the position of the operator is always in front of his tool, this lever is always under his hand, and the motor can be stopped or the speed changed instantly from any speed in one direction to any speed in the other direction. As it is no trouble for the operator to change his speed, it is found in practice that he always keeps the tool cutting up to speed, which he generally does not do when he has a belt to shift. As the speed can be changed without stopping the lathe, the cutting speed can be kept constant as the tool works toward the centre in facing off work, or the operator can avail himself of a quick return

in chasing threads. This method is very desirable in turret lathe and similar work, where there are no two tools in the turret that should be run at the same speed to get the greatest amount of work from the tool. Most turret lathes have some mechanical arrangement for quickly throwing in or out some clutch or gears, thus giving two speeds without shifting a belt; but the advantage of being able to instantly get any one of nine speeds in either direction without either shifting a belt or throwing a clutch, will be appreciated.

Another interesting application carried out by the Card Co. is the direct driving of a Miehle printing press. The motor is directly attached to the main driving shaft of the press in the place of the ordinary driving pulleys, and takes up no more room. It runs at five speeds in the forward direction, and has one slow speed to back up. Any one of these speeds may be obtained instantly without any effort on the part of the pressman, simply by moving a lever on either side of the press. There are no belts to shift or to generate static electricity, which is so disastrous to the rapid working of the press. The press runs very much more steadily with the motor than with a belt, and may be set up in the most convenient position without any respect to line shafting.

The Card Co. are thorough believers in the direct driving of shop tools by motors, and every motor in their shops is run by its individual motor, without the noise accompanying belt driving and with entire freedom from dirt or grease.

ELECTRIC DRIVING OF TOOLS IN THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA.

There are perhaps no more conservative people than the owners of industrial establishments and among these the machine shop owners probably rank first in their reluctance to change over or discard older machinery for the more improved types. To have even hinted at driving machine tools, by independent motors a few years ago would have called down ridicule upon the head of the advocate of such a method, and yet the experience of the

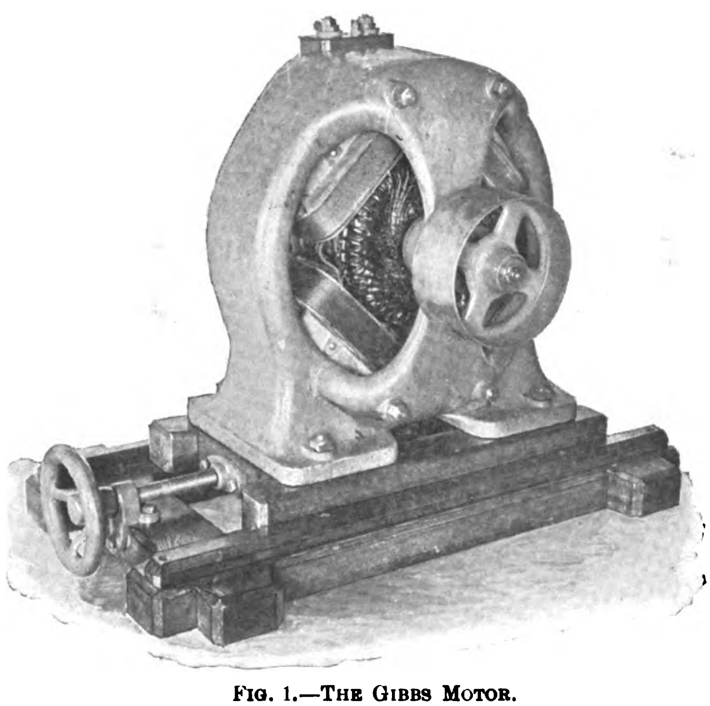


Fig. 1.—The Gibbs Motor.

last few years indicates that sooner or later the electric motor will supplant the belt and shafting, perhaps even to the smallest tool. We are justified in making such a statement by the many instances already recorded of successful installations of this character both here and abroad and by the further confirmation afforded by the work now being done by the electric motor in the great Baldwin Locomotive Works in Philadelphia. In describing this installation in our excellent contemporary, the *American Machinist*, of June 6, Mr. P. Drolan shows that, to begin with, 250 h. p. of Westinghouse engines driving dynamos supplying the motors with current have displaced 500 h. p.

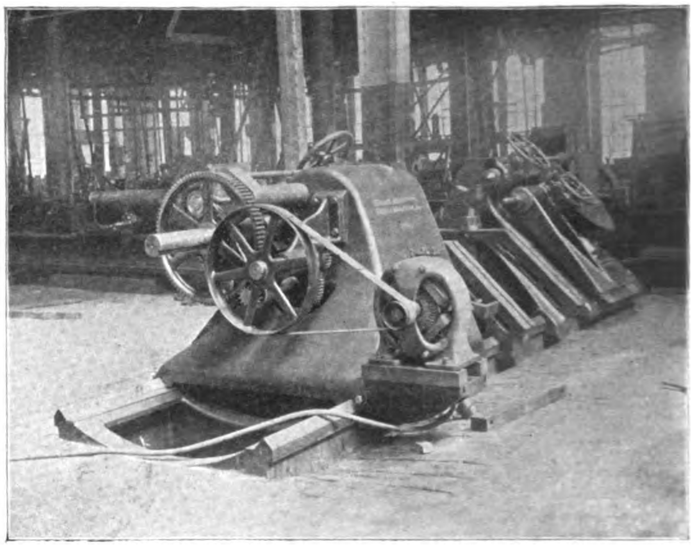


Fig. 2.—Gibbs Motor Driving Quartering Machine.

of a much more expensive type of steam engine to do exactly the same amount of machine driving; and he estimates that the actual effort required to do the machine work was not 10 per cent. of that developed in the engine cylinder under the old régime with belts and countershafts.

Our contemporary gives a number of views of tools driven by individual motors, from among which we select that shown in the engraving Fig. 2, which shows a motor driving the heaviest of the Baldwin quartering machines. This is a massive tool, built by Bement, Miles & Co., the bed alone weighing 35 tons; the design affords a model of elegant simplicity, and with its neat and excellent arrangement of the electric drive this beautiful machine may be justly said to represent the latest and best practice in locomotive tool building.

The motors employed in the Baldwin shops are all made by the Gibbs Electric Co., of Milwaukee, Wis., and Fig. 1 shows the construction of the "M" type. The frame of the machine consists of two pieces only, rabbeted and bolted together. Up to 9 k. w. the brushes are fixed and need no adjustment, the design being such that no sparking occurs with any change of load. All connections, cables and wires are held in fixed positions, thus avoiding frequent annoyance and danger. The Gibbs "M" type motors vary in speed from 1,150 revolutions per minute for the 400-pound, 2 k. w., to 950 revolutions for the 1,540-pound, 9 k. w., motor, there being three sizes of 3, 4, and $6\frac{1}{2}$ horse-power between these two extremes. Besides the saving in power consumption effected by the introduction of the electric motor into the Baldwin works, according to Mr. Drolan there is a decided gain in output due to the perfect readiness of the motor to operate at all times, and to the more delicately suitable speeds which can be had through independent motor driving. The men in the Baldwin shops work almost exclusively on piece prices, and their strong preference for the independent electric drive can only be explained on the ground of increased product with the same labor. Part of this increase is undoubtedly due to increased light, but the increased light cannot be had while the overhead belt and countershaft drive is used, so that all the increase of output is justly to be credited to the electric drive.

THE INTERIOR CONDUIT AND INSULATION CO.: ITS PRODUCTS AND MANUFACTURING METHODS.

LESS than ten years ago the art of interior wiring in this country was in a state of chaos, with no governing principles, with the crudest appliances and with an utter lack of skilled, experienced workmen. Moreover, it tended to go from bad to worse, and to become "a thing of shreds and patches." The incandescent light had, it is true, proved its superiority over other illuminants, and there was a growing demand for it; but the methods that had sufficed for bell wiring, telegraphy and telephony were sadly inadequate to the new problems, and the material used was rarely of high quality. Even when the insulated wire was good, it was embedded and lost in the plaster of the walls, crushed under the tiling and the bricks, or, if carried exteriorly, held up by cleats and moldings that made no attempt at decorative effect. Grounds and short circuits were innumerable and inevitable, fires were alarmingly frequent, and repairs or renewals of circuits were often so costly and disastrous that the owners of fine houses preferred not to attempt them.

Yet this was the chosen field for the advance of electric lighting—the field to which Mr. Edison had turned because it counted for 95 per cent. of the possible business while street arc lighting was but a possible 5 per cent. Were its great opportunities to be nipped in the bud, or was some new departure to be the means of success? That momentous question—far more vital then than now, when the art has made such tremendous advances—was taken up and answered by Mr. E. H. Johnson in the Interior Conduit system devised by himself and Mr. E. T. Greenfield. These two pioneers and experts did not reach a full solution of the problem at once, nor could they have done so had they tried, for the very art of architecture was at that moment itself beginning, in its bridge type of metallic construction, one of the most important changes and evolutions it has ever seen. But taking conditions as they found them, and trying first a light form of paper conduit, they at once put in the hands of the architect and builder the apparatus which enabled him to treat electrical wires, of whatever class, as scientifically and as easily as though they were water, gas or steam pipes. We are not now discussing mere points of priority. Let it be granted that there had been speaking tubes through which once or twice wires had been run for a short distance. Such casual, haphazard methods would no more answer for the perfect wiring of a modern building than the strap rail would answer for trolley traffic. Aside altogether from the reduction of appliances that were not even experimental, to an organized system with parts, plan, and fine adjustment, there was the radical difference in the fact that Messrs. Johnson and Greenfield aimed at an insulated pipe or wireway as the fundamental feature of their work.

There is no necessity here to write the history of wiring, but it may be noted that from the work of these two men, beyond any cavil, dates its modern and best period. Associated with their original idea also was that of a twin conductor in the one duct, on the principle that if there were to be a breakdown of the circuit, it might as well come quickly and be done with, proclaiming its occurrence at once, rather than smoldering in silence and awaiting the tardy rupture of an ill-proportioned fuse. That idea is still an integral part of Interior Conduit work, but in the meantime the conduit itself has seen some interesting developments. To-day "plain" tube is in large demand, and it will always be, but experience soon led to improved methods of protecting it against ill-usage. The first step was the resort to a brass armor, which was hailed with enthusiasm by architects and is now highly popular for private houses and smaller buildings. But the growing use of girder steel in the modern office building, and the disposition to favor rigid materials in keeping therewith, led to the introduction of iron conduit, the use of which is already enormous, it being turned out by millions of feet to go into buildings from one end of the country to the other.

II.

That Interior Conduit had to fight its way, and to overcome criticism and opposition, goes without saying; but to-day it has the endorsement of the underwriting bodies of America, and is being rapidly introduced all over Europe. That it should be imitated, or that numerous efforts should be made to improve upon it, was equally natural. That it should lead to the production of a whole new class of auxiliary appliances and apparatus, was inevitable; and it was out of this condition of endeavoring to meet the needs of a new market that the Interior Conduit and Insulation Co. had its origin. At first, the company devoted its energies entirely to the production of conduit, joints, junction boxes, cut-outs, and other subsidiary details, and there was plenty to occupy its time; but the solicitations of the supply trade, as well as the repute of its founders for enterprise and progressiveness, led it to take up a number of other processes of manufacture. It will be remembered that Mr. Johnson had been in closest relation to the lighting art from its birth, had done much to establish the trolley industry, and had labored incessantly for the popularization of electric motive power in mill and factory; all of which enabled him to grasp with quick intuition the merits of any new device brought to his notice. He was desirous, however, of having certain work attempted, and found an admirable coadjutor in Mr. Robert Lundell, a young Swedish engineer now well known; with whom he has done much valuable work in recent years and whom he has helped to bring out a variety of new electrical inventions and machines.

It thus comes about that under the one roof of its headquarters and factory at 527 West Thirty-fourth street, New York, the Interior Conduit and Insulation Co. carries on successfully the production of more distinct, though related, lines of industry than are to be found in any similar factory in America. The nearest approach to its versatility might perhaps once have been found in the old Brush factory, at Cleveland, or the more recent Thomson-Houston works at Lynn; but it is decidedly a leader to-day in the variety of its ingenious products; while there probably never was an electrical concern that dealt practically and successfully with so large a range of work on so modest a capitalization. And while the company is seriously limited in its present overcrowded factory, in the building of large generators, it may be questioned whether any concern has excelled it in economical turn-out of product.

III.

An exterior view of the fine seven story and basement factory of the Company is given in one of our full page illustrations; and grouped around it are views of the executive offices, the rooms for clerical work, the factory manager's office, the laboratory and the shipping department. The power plant and heavy testing room are in

the basement, under the offices in the front of the building, and the floors above the first are devoted to the regular electrical lines; while the manufacture of conduit is carried on in the rear floors and buildings. The differentiation between the conduit work and that in other departments is so sharp that it may well be observed in a description of the processes employed. While many of the details of Lundell dynamo and motor manufacture are new, the work necessarily follows principles that are familiar; but in the conduit shops, it is an entirely new, and hitherto undescribed art that unfolds before our eyes.

Plain interior conduit is made in nearly a dozen standard sizes, ranging from one quarter inch inside diameter up to two and a half and three inches. Its basis is a special quality of what is technically called "sheathing paper," which, according to the size of tube to be made, varies from twelve one-thousandths to thirty one-thousandths in thickness. It may seem a little matter, but the Interior Conduit & Insulation Company had considerable difficulty in convincing paper manufacturers that when they specified such thicknesses they wanted them exact. A slight variation would make a great difference in the finished conduit and in its adjustment to the other carefully gauged parts of the system, such as junction and branch boxes. The paper is delivered at the factory in large rolls, accurately cut into strips on ingenious machines devised for the purpose, and then rolled in ribbons upon spools. The width of the ribbon strips is governed by the diameter of the tube to be made. The spools are then carried to the tubing machines, as shown on page 557, and there mounted on stands in such relation to the revolving mandrel that the paper as drawn in and forward makes a tube. There are four layers, two twisted for the core and two abutting in an overlap from right to left. One "overlap" passes through a paste pot as it enters the machine and the flour paste on each side adheres to the other strips. The tube is dried as it comes along by means of traveling gas flames which carbonize the paste at the cutting point and prevent the green tube from unravelling. The tube is rapidly sliced off in lengths of about ten feet, which tumble into troughs, the smaller sizes much resembling stout sections of macaroni or spaghetti. The machines are the result of long study and much cleverness. They need little attendance, and one of them will reel off 15,000 feet in a single working day.

IV.

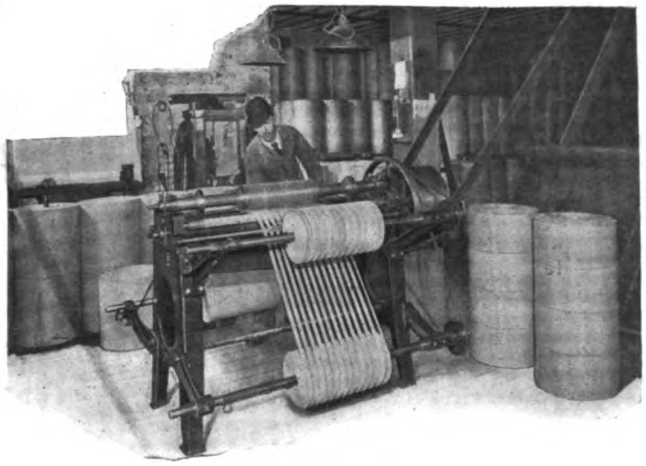
After the tube has left the machines it is gathered in large bundles and carried to the drying room, where it lies for a week in racks, slowly giving up its moisture to the warm air. As much as 2,000,000 feet will be stacked here in busy times, en route to the vulcanizing room which adjoins. At the end of the period of drying, the green tube is taken down and put into metal "cribs" or crates, which look somewhat like fantastic lobster pots, some longer, some rounder. One of these crates will hold 5,000 feet of three-eighths inch tube, or 800 feet of the largest size. When the package has been made up, it is slung upon a strong overhead railway and carried through the fireproof doors into the inferno known as the vulcanizing room or "curing house." (See page 558.)

The curing house is a separate building in a well formed by others and contains a series of huge vats or tanks in the depths of which boils the curing compound, the basis of which is petrolite, a by-product of petroleum. These vats run vertically through two floors, and are 32 feet in height. By means of superheated steam the liquid is kept at a heat of 500 degrees, and the cribs with their green tube are gradually immersed by an attendant who patrols the mouths of these black pits quite nonchalantly. The duration of the dipping process is a little under an hour, and the tube comes out thoroughly cured. Visitors to this part of the establishment are only too glad to escape from it quickly, interesting as it is, but the demon in charge see-saws his cribs up and down over the steaming holes, his equanimity being maintained by a lusty Lundell motor that delivers a cool breeze to him all day long. Cribs of green tube are constantly arriving, and cribs of cured as incessantly leaving; and the scene, if rather gloomy, is one of animation. Special pots and cribs are used for curing elbows and boxes, it being necessary to keep them properly curved and shaped.

V.

The tube, being now released from the iron bondage in which it was subjected to the ordeal by fire, is taken to the finishing room. A machine with gripping sprockets seizes each stick and runs it through a vat of another mixture which renders it alkali proof. This machine handles as much as 50,000 feet per day. When rodded, to make the bore smooth, the plain tube is now ready for bundling and shipment; but a very large proportion of it next has to be converted into "iron armored conduit" or "brass armored" conduit.

In making iron armored conduit, the plain tube is brought to a workman who thrusts each length into a tank of insulating mixture kept hot by steam. On the other side of the vat stands a workman close to two large ovens in which iron pipe is piled up. The iron is heated up by steam coils to about 300 degrees and each time a plain tube advances it is housed in the iron pipe, a play of about one-thirty-second of an inch being allowed. The ends are then loosely closed up by stop-pieces, and the iron conduit is rolled off into a receptacle. As the iron cools, of course it contracts upon the inner tube, and the union thus formed is so intimate that it is impossible to detect, by merely looking at it, where the iron begins and the paper leaves off. The solidification of iron, paper and compound is perfect. But the ends of the iron conduit have now to be cut off, reamed, and screw threaded, and a screw coupling has to be put on each end, so that in use the lengths can be brought together, the insulation in each being abutted, forming a continuous channel of insulation. Obviously the protection thus afforded to the wire within is the highest that could possibly be afforded. Bare iron pipe will succumb to short circuits which it has itself



CUTTING UP PAPER FOR INTERIOR CONDUIT TUBING.

invited, but here the insulation prevents such a casualty, while enjoying the best safeguard against mechanical injury that can be obtained. Within such pipe, it is believed, the twin conductor offers the final solution of getting the greatest amount of conductivity into the smallest space, and at the smallest cost, with the greatest efficiency and safety.

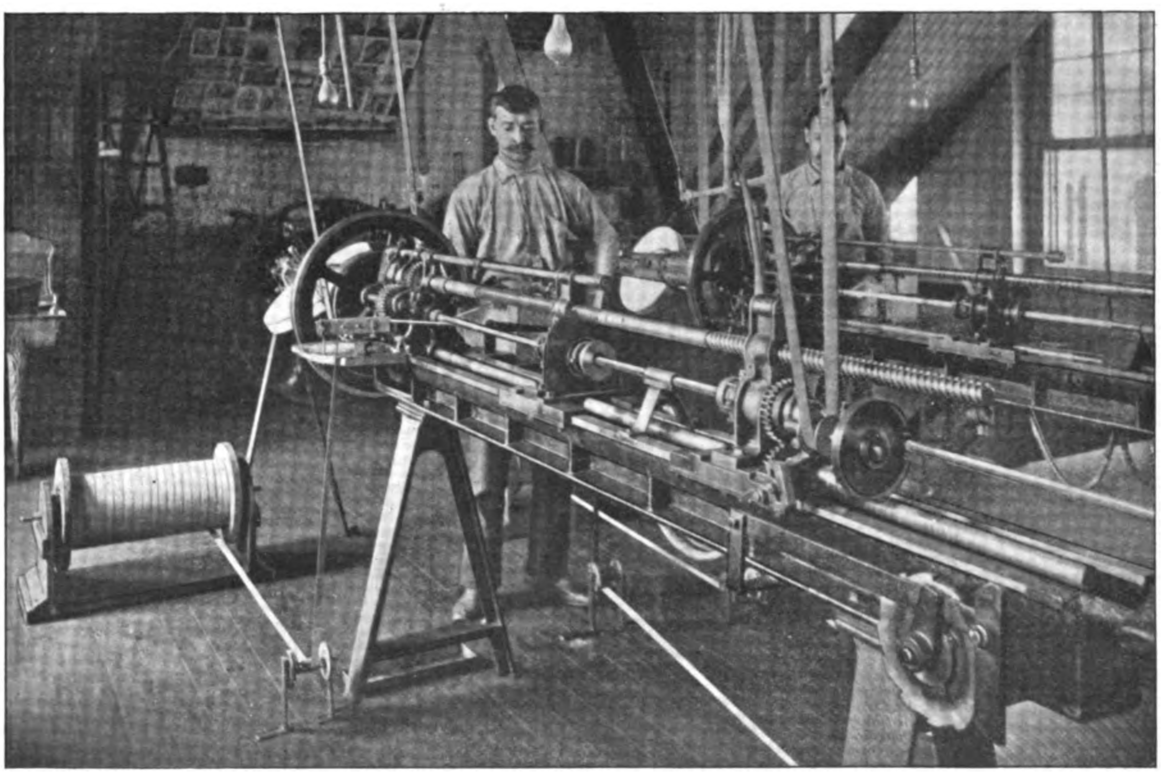
Before the iron armored conduit leaves this department it is again rodded, to make sure that the raceway for the wire is smooth and clean. It is then ready for shipment in bundles.

VI.

Brass armored conduit was an earlier evolution in the art than iron armored, but the tremendous vogue of the latter has deprived it of some of its importance. Nevertheless, it is in great demand, and the machinery for its production is kept in strenuous activity all the time. Its production is a simple but ingenious process. Plain tube is fed into the machine and brass tape is served also. As the tube advances, the tape is bent over by a series of fingers. The tape is not twisted but is folded together straight, with just enough selvage to make a flap which is brought over and flattened down in a lock seam, the crease being very smooth and flat, and so tight as to be wholly waterproof. After the length of brass conduit has thus been made, it is notched at each end in such a way as to allow a small part of the brass to be snipped off. When the lengths are brought together for use in construction work, a sleeve goes over the two ends, and the run of insulation is thus made continuous. Brass armored conduit combines a high degree of strength with lightness, and hence finds frequent use in places where neither plain tube nor iron conduit is desirable. It has been a great means of reducing to system and simplicity the wiring of private houses.

VII.

There are naturally many auxiliary appliances in Interior Conduit, such as couplings, elbows, junction boxes, etc. Not only have these been reduced scientifically to a common, interchangeable standard, but they have been perfected by a variety of those subtle little touches that only time and experience can teach even the most observant. In a department immediately adjoining the brass conduit room, the work is carried on of building up these supplementary devices, so far as they relate to conduit. At one long bench, a number of men and women are employed in what looks like paper box making but is in reality the fitting of the insulated interior into the metal shell of the feeder, main and branch junction boxes for the two and three wire systems. At another long bench, conduit elbows are being bent into shape by hand pressure, with the help of rattan and rubber shapers and notched wheels to take up the slack of the redundant metal on the inner curves. Window bushings are also made here, and it is particularly interesting to see the iron armored conduit elbows bent into any desired curve by means of hydraulic pressure, resort to which has proved highly economical, the production of iron elbows at one time



METHOD OF WINDING PAPER TO FORM INTERIOR CONDUIT TUBING.

costing several cents apiece where they now cost only fractions of a cent.

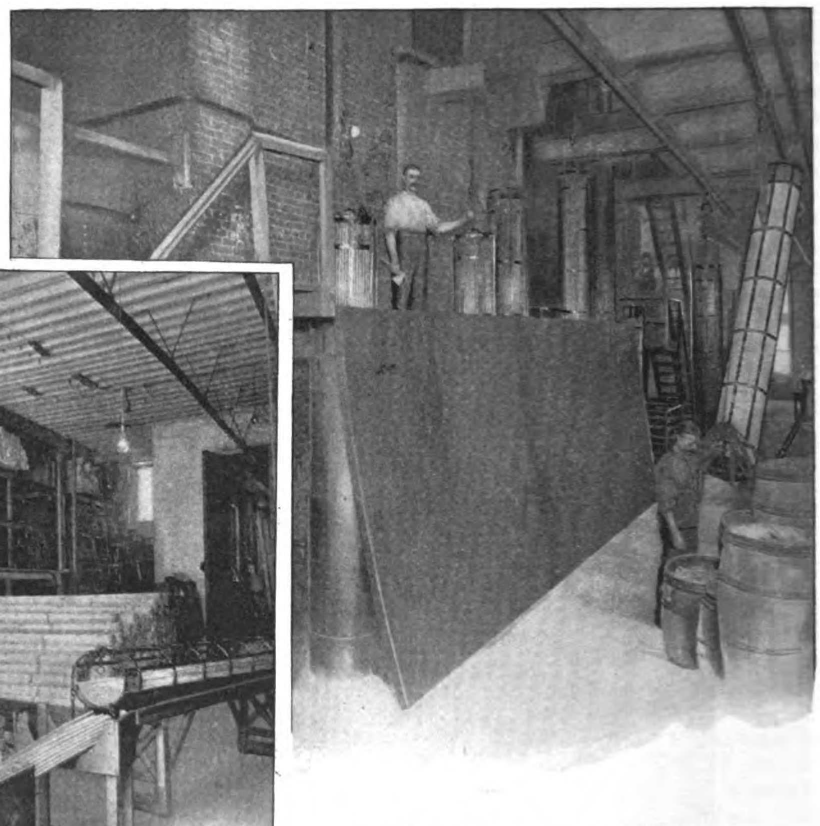
In introducing a novelty, samples are always helpful, and from the very first there has been an insistent call for sample boards of Interior Conduit, not alone for supply houses, but as object lessons and for purposes of instruction at schools, colleges and exhibitions. The Interior Conduit & Insulation Co. has a snug little sample board department which is busy all the time building these boards in various sizes and styles and shipping them not only all over the Union but to all parts of the known world. Interior Conduit has found its way, moreover, into a variety of fields, owing to its ability to resist acids, alkalis, etc.; and is particularly favored for aquariums using salt water, where rubber and metal of all kinds have broken down under the severe test imposed by the brine.

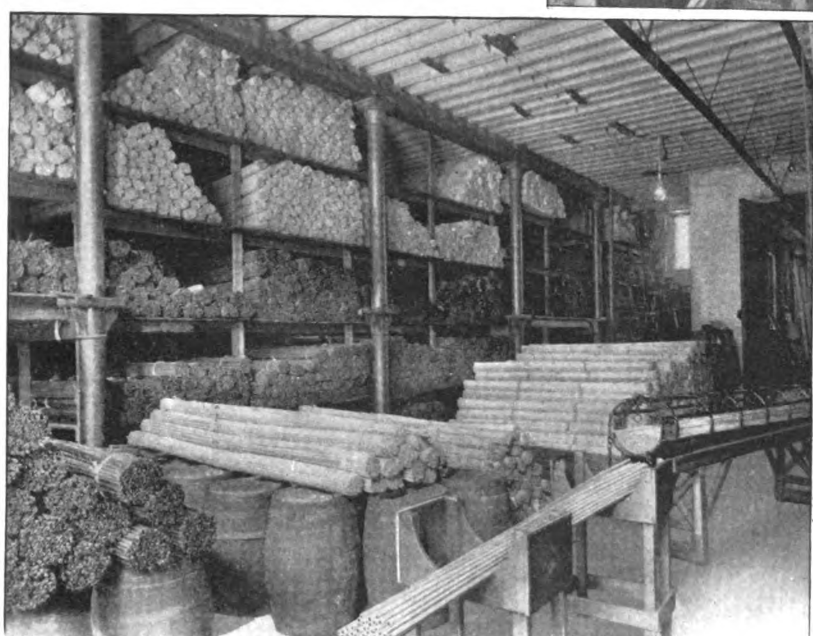
VIII.

While the conduit system was originally intended for interior work, its use was early suggested for underground purposes. The plain tube was hardly suitable for the purpose, except as to insulating qualities, but the later modifications with iron pipe made it desirable and effective. It has been used recently during several months of winter in connection with underground trolley railway work, to which further reference will be made; and every test showed the insulation to be the highest attainable. The system is based upon a telescopic arrangement of the tubes, and promises rapid adoption with the inevitable increase of sub track electric railroads.

Connecting links between the Interior Conduit work on the one hand and the dynamo and motor work of the Company on the other, may be found in the multitudinous devices that are of use in any system for interior light and power, whether tubed or not. One of these is the Johnson vise lock switch, the capacity of which little mechanism for breaking a heavy current is simply phenomenal. A switch, only four inches square, handle and base included, will take care very comfortably of 100 amperes. The power employed for effecting the automatic shutting of the vise is a helical wire spring put under stiff tension by each throw of the switch handle and operative to throw back the released jaw to its normal position with such force as to effect a positive wedging of the jaws, alternately locking the circuit closed and locking it open. The release of the lock is effected as in an ordinary vise by simply turning the screw-threaded handle until the free jaw is withdrawn sufficiently to allow it to move over the contacting stop faces. The switch will easily break a current of twice the normal 120 volts, even when carrying a current far above its rating.

A further application of this principle is embodied in another device due to Mr. J. Van Vleck, and built also by the company. It is designed to be placed at the inlet of the three wire system to buildings, and is the point at which all the circuits for light and power are controlled, it being known as a "Service End Cut-out." An insulated pipe brings the wires into a chamber of metal filled with





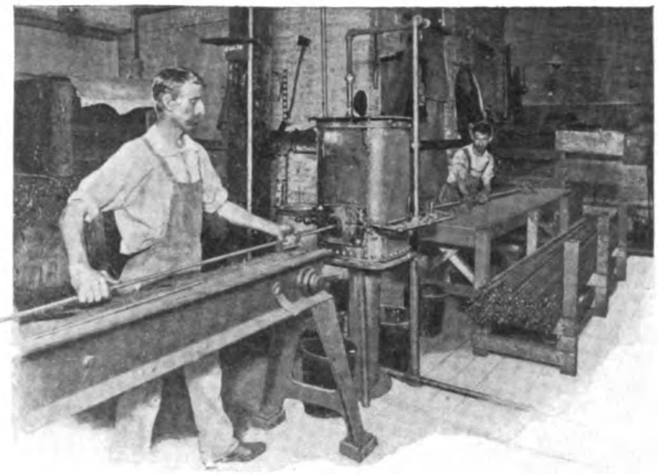
THE DRYING AND CURING DEPARTMENTS.
(See page 556.)

insulating compound, through which they are led to the porcelain base of the switch. Being hermetically sealed, the switch withstands dampness, and it is an extremely handy piece of mechanism for firemen and wiremen to get at and manipulate.

Pendant switches are another variety made by the Company, the object being to dispense with key sockets. The flexible cord runs to a spring in the ceiling shell, and a pull at either the lamp itself or the knob on the cord, closes the circuit, another pull opening it again. A form of this switch is also applied to chandeliers in plain or combination fixtures, so arranged that all the lights can be turned on or off at one pull, or consecutively.

IX.

We come now to the dynamo and motor work of the company, and find ourselves confronted by a singularly wide variety of apparatus, all due in the main to the genius of Mr. Lundell and developed out of one or two leading types. Several thronged and crowded floors are occupied by this work, and just at this writing the com-



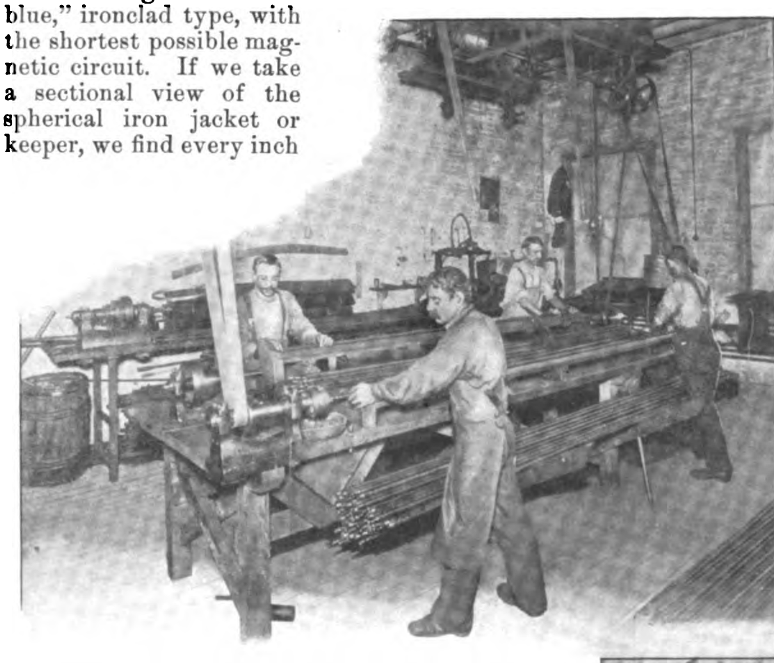
Making Iron Armored Interior Conduit.

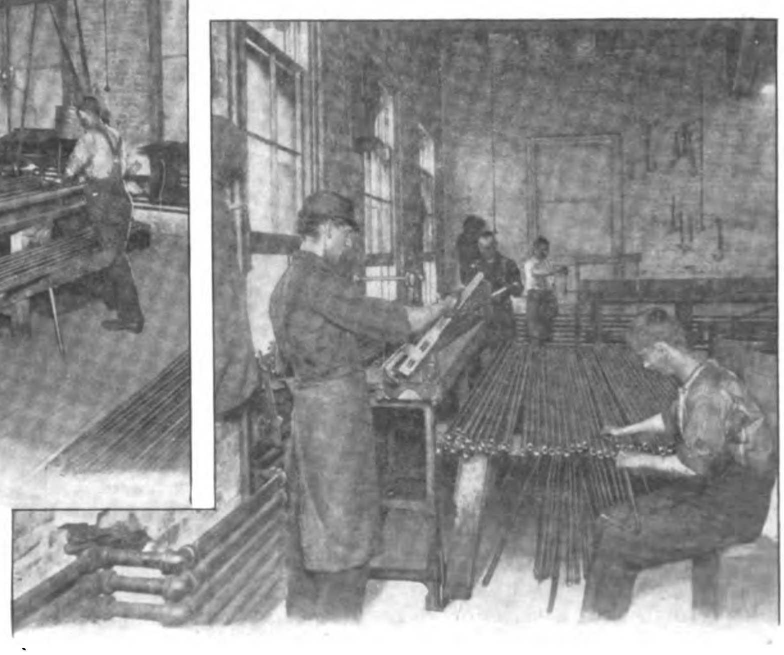
pany is running at its highest capacity to fill the orders raining in for its popular fan motors—as many as 1,200 in a day being ordered, and 400 or 500 for days together, as the present writer knows from seeing the orders themselves. Taken individually, each little fan motor does not represent many watts, but when the energy is summed up and is supplemented by other figures, of motors for large ventilating fans, for elevators, printing presses, mills and factories, the total assumes proportions of the utmost significance as to the future of electric power.

The Lundell fan motor is not only a boon to thousands of suffering mortals in hot weather but is a comely thing to look upon. In the last three years it has won a front place in its class, and though its price has been maintained, in keeping with the quality, the demand has increased with prodigious bounds. One cannot visit a single city of any importance in which the "Lundell" does not at some point or another puff out a friendly cooling breeze of welcome. The Lundell is, moreover, of such distinct form that it is readily recognizable. The motor proper is a sphere, and the field magnet is of the genuine "true blue," ironclad type, with the shortest possible magnetic circuit. If we take a sectional view of the spherical iron jacket or keeper, we find every inch of the interior put to effective use. There is but one magnetizing coil, with few turns of wire. The armature is of the Pacinotti drum form proportioned for high efficiency, and so adjusted to the peculiarly shaped pole pieces that the reactions leave the motor sparkless under all conditions. The point of commutation never changes, and the little carbon pencil "brushes" held against the commutator by small spiral springs, stay where put. The bearings are self-oiling, and the motor runs for months without the slightest attention. Its spherical shape, moreover, permits its use in any position, and it is fitted to desk stands, brackets, posts, swinging chains, ceiling stems, window frames, bookcases, bedsteads and almost any other piece of furniture that could be named. The regulating switch, fitted in the base, if standards are used, gives three speeds, namely, 800 and 1,200 and 1,500 revolutions per minute. The fan is fitted to the end of the spindle of the armature close to the iron shell and is housed in a guard, the blades and guard being japanned in order to minimize the dazzling effect which with plain brass often becomes objectionable to critical and nervous people.

This fan motor was first brought out for direct current work, but the Company is now building another form of it for alternating currents, and is achieving a further great success. The Lundell alternating fan motor has a cylindrical field magnet mounted upon a hollow cast iron base, and is built for high frequency, up to from 14,000 to 16,000 alternations per minute, as well as for low frequency, at about 7,200 per minute; at voltages of 52 and 104. The high frequency motor, with 12 inch fan, takes only 1.3 amperes at 52 volts. These alternating fans, like the direct, are richly finished, in heavy black japan with gilt stripes, plated fittings, and self-aligning and self-oiling bearings.

The illustrations on pages 562 and 563 give but a poor idea of the intense activity pervading the fan motor department of the Company at this season. Hundreds and hundreds of motors are on their way from stage to stage, and as each batch goes out, the benches are piled high with the laminæ castings fittings, and details for another lot wanted in haste that is not merely 98° hot, but 120° urgent. At one point, the motor shells are being assembled and wound; at another, the little armature discs are being stamped out; at another wire guards are being twisted out of brass; and near by, scores of fan blades flutter on strings like big captive black,

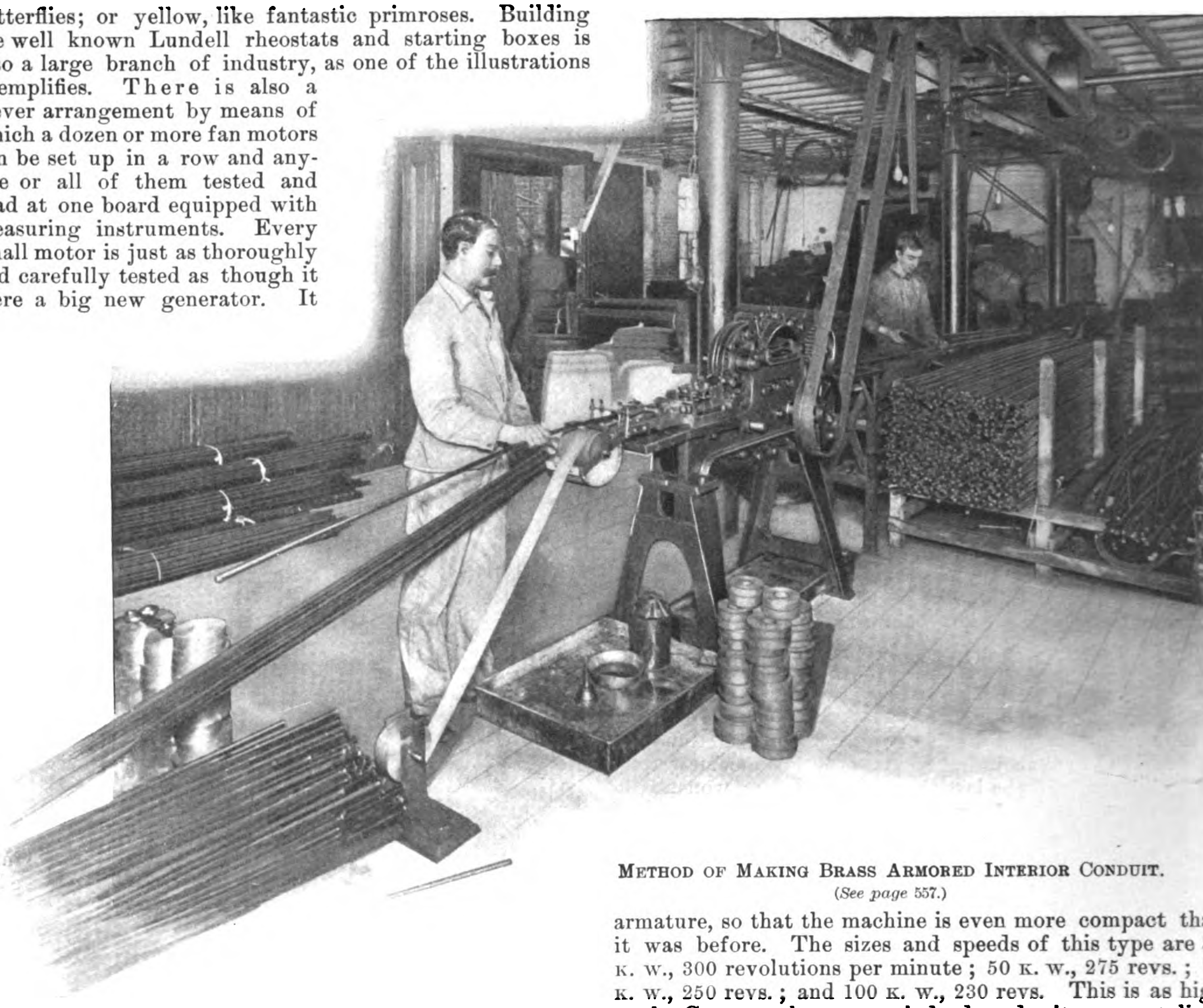




Processes of Reaming, Threading, Coupling and Rodding Iron Armored Conduit.

(See pages 556 and 557.)

butterflies; or yellow, like fantastic primroses. Building the well known Lundell rheostats and starting boxes is also a large branch of industry, as one of the illustrations exemplifies. There is also a clever arrangement by means of which a dozen or more fan motors can be set up in a row and any-one or all of them tested and read at one board equipped with measuring instruments. Every small motor is just as thoroughly and carefully tested as though it were a big new generator. It may be added that among work in hand when the factory was visited recently were fan motors made perfectly water-tight and painted to match the white ornamentation of the steamship for which they were ordered. The use of fan motors on shipboard is growing rapidly.



METHOD OF MAKING BRASS ARMORED INTERIOR CONDUIT.
(*See page* 557.)

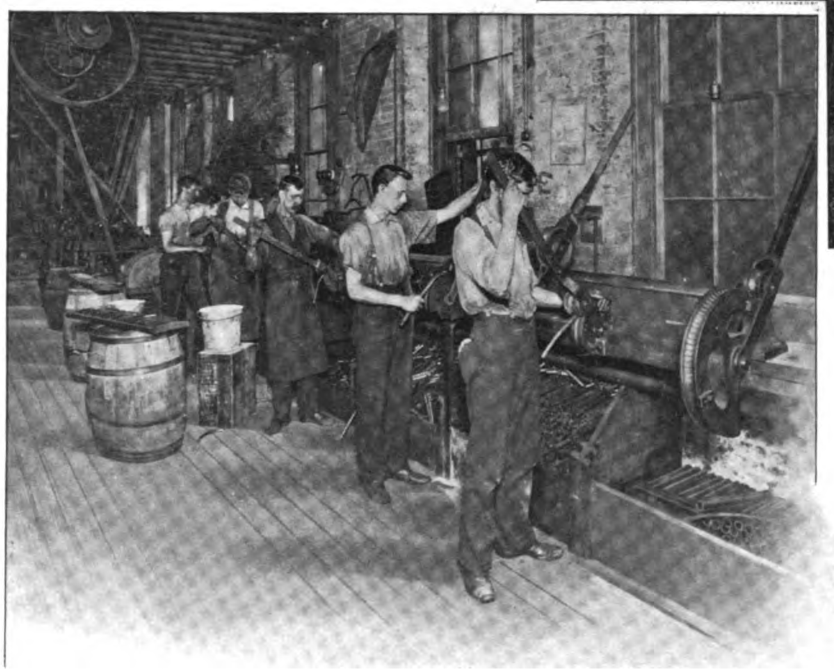
But enormous as is the demand the year around, and especially in the summer months, for Lundell fan motors, this branch of the Company's work is relatively small. In this factory there are built also power motors of the two pole type up to 4 H. P. and of the four pole type from 5 H. P. up to 35 H. P.; all of which have been applied most successfully to a large variety of work. The main feature in the successive forms of this motor have been the use of but one magnetizing coil and an armature of the Pacinotti type, the field magnet halves being brought together so as to make a protecting shell which is also a portion of the magnetic circuit. In some of the earlier types the armature shaft was carried by an exterior spider bolted to the shell; but in the later forms, the axle bearing is supported by a pillow block on an extension of the base.

X.

The Interior Conduit and Insulation Co. has been very active also in the construction of dynamos for work where space is limited, and where the shape of the Lundell machine further recommended it; and some of its marine installations have been highly successful. It has of late added to its list a series of slow speed compound wound generators for direct connection to high speed engines, with the commutator disposed on the periphery of the armature, so that the machine is even more compact than it was before. The sizes and speeds of this type are 30 K. W., 300 revolutions per minute; 50 K. W., 275 revs.; 75 K. W., 250 revs.; and 100 K. W., 230 revs. This is as high as the Company has gone; indeed, under its present limitations of space and convenience, it could go no higher, pressing as have been the requests to it for large generators. The present factory is thronged by hundreds of busy workmen, who find it difficult to carry out the work even now; while there is no possibility of handling the large castings and other pieces essential in generators of the modern bulk. The problem here presented is obviously

DEPARTMENT FOR BUILDING INTERIOR CONDUIT SAMPLE BOARDS.

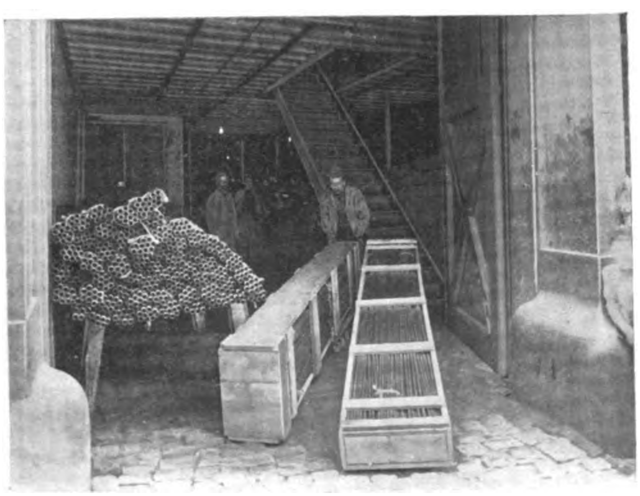
one that the Company must meet in the near future. Meantime every advantage is taken of the facilities, and as the photographic views indicate, a most interesting variety of dynamo construction is in progress, including special Lundell dynamos, with heavy fly wheels, for gas engines; dynamos for yachts, residences, factories, &c.; large motors for mills, stores, &c. Everything is exhaustively tested, whether in Mr. Lundell's little private laboratory, in the shops, or by actual practical load. It might also be mentioned that the Company has also carried its



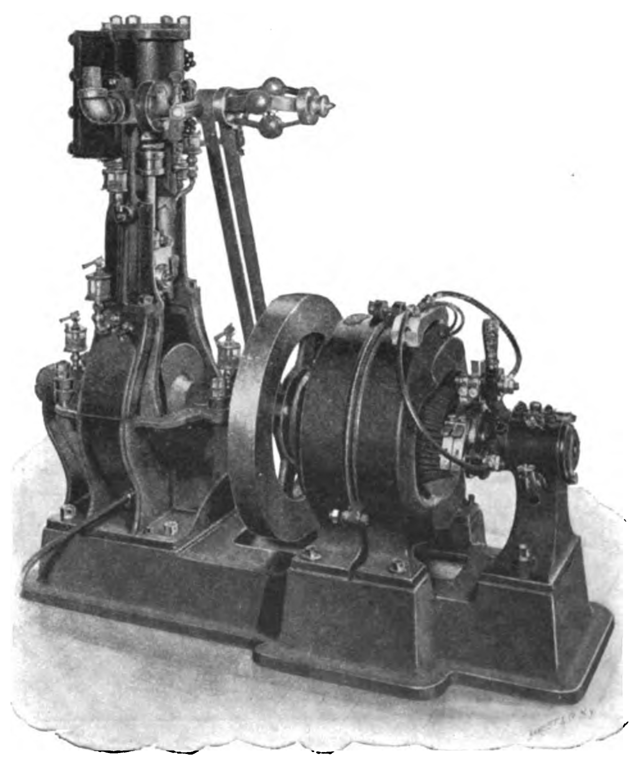
Making Interior Conduit Elbows, Junction Boxes, and Other Detail Parts.

work in the alternating field to a satisfactory point, and stands ready to supplement its new alternating motors by generators, transformers, &c.

To exemplify the installation work of the Company, an illustration is here given of the direct-connected plant placed on Mr. Harrison B. Moore's new steam yacht the "Marietta." This plant consists of a 4x4 Sturtevant single valve, upright engine, directly connected by a rigid coupling to a $2\frac{1}{2}$ K. W. Lundell generator of the four-pole type. The plant runs at 500 revs. per minute, the engines developing 5 H. P. at this speed. The $2\frac{1}{2}$ K. W. generator furnishes 29.4 amperes at 85 volts, for 42 lamps of 80 volts and 16 C. P. The generator armature is cross connected, thus necessi-



Shipping Plain, Brass Armored and Iron Armored Conduit.



Lundell Plant for Yacht Lighting.

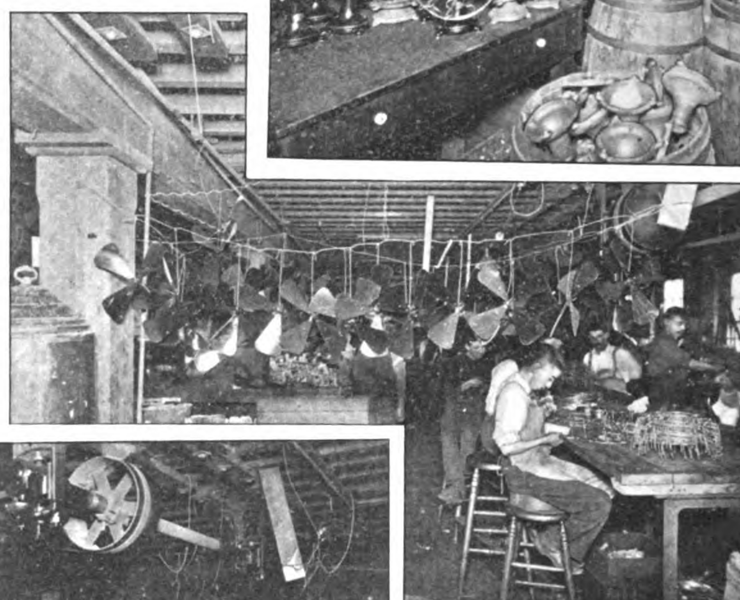
DYNAMO AND MOTOR BUILDING AND TESTING DEPARTMENTS OF THE INTERIOR CONDUIT & INSULATION CO.; ALSO DISC CUTTING AND RHEOSTAT MAKING ROOMS

Headquarters of The Interior Conduit & Insulation Co., New York, Showing Factory, Executive Offices, Superintendent's Office, Store Room, Laboratory, etc.

tating only two sets of brushes. The plant runs very quietly, and is sparkless at the brushes. For such installations the Company experiences a steady and growing demand.

XI.

So far nothing has been said about the railway work done experimentally by the Company, but it cannot very well be passed over, as the experiments have all been begun in this factory and all the apparatus has been built here. Mr. Johnson's close relation to the electric railway industry has led him to some very decided convictions, and one of these, it may be stated, is as to the evanescence of the overhead trolley as a cumbersome and ugly method. Numerous studies and trials by himself and Mr. Lundell have led to the evolution of a system which for more than a year past has been subjected to rigid test and scrutiny, and of whose working only good can be said. In the Johnson-Lundell system, the track is of ordinary construction as to the rails, between which lies a conducting bar or strip of metal embedded in asphalt or stone. This strip is flush with the surface, and is divided up into sections by insulating blocks of stone or other material. Alongside the track are placed switch boxes with covers set into the street paving so as not to project above it. In these boxes are electro-magnetic devices which deliver current to each section as the car comes along and then lie dead until the succeeding car rolls up. These switch boxes govern the section



BUSY SECTIONS OF THE LUNDELL FAN MOTOR DEPARTMENT.

of track immediately adjoining, and are of course rendered watertight with dovetailing joints, gaskets, etc. The car carries a pivoted rubbing brush which travels over the surface of the contact rail, and picks up current for the motor. The section is dead at all times except when the car is passing over it. The car itself is equipped with but one motor, driving on each axle by means of bevel gear, and with sprocket wheels and link chain in flexible connection with it. The suspension of the motor is flexible, and by means of an ingenious bipartite screw coil in close relation to the armature shaft, the motor though capable of instantaneous arrest or sudden starting, never jerks whether starting or stopping. The result is that a smaller motor is able to handle the car than is ordinarily the case, while as the whole weight is not lifted at once from a state of dead rest, the consumption of current is minimized. The motor and all working parts are boxed.

The car does not depend however, merely on live exterior current which may be cut off, and often is cut off, from a trolley car. It carries under the seats a set of simple lead secondary batteries, enough to furnish the normal voltage of 300 at which the car runs, and of considerable ampere capacity. These batteries are always in place, charge from the circuit, will carry the car through emergencies and over steam railway tracks, crossings, etc., which need not therefore be wired; and serve also to "pick up" the circuit again

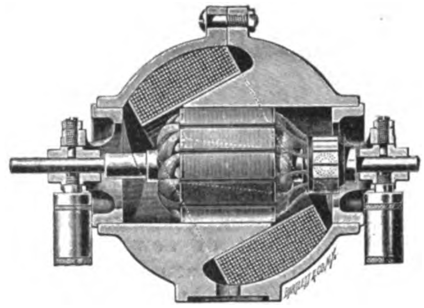
BANK FOR TESTING FAN AND OTHER SMALL MOTORS.

as the car starts, as well as for lighting the car, etc. Moreover in the Johnson-Lundell system the car control is effected by the movement of but a single lever, which not only brings about the electrical changes that determine the varying speeds of the car but replace the brake, as the car is brought to a stop by electrical means solely, the motor being converted into a generator and delivering current to the line. The effect of sudden stoppage is remarkably instantaneous and yet is not at all dislocative of one's physical structure ; it seems only as though the car had struck a feather bed.

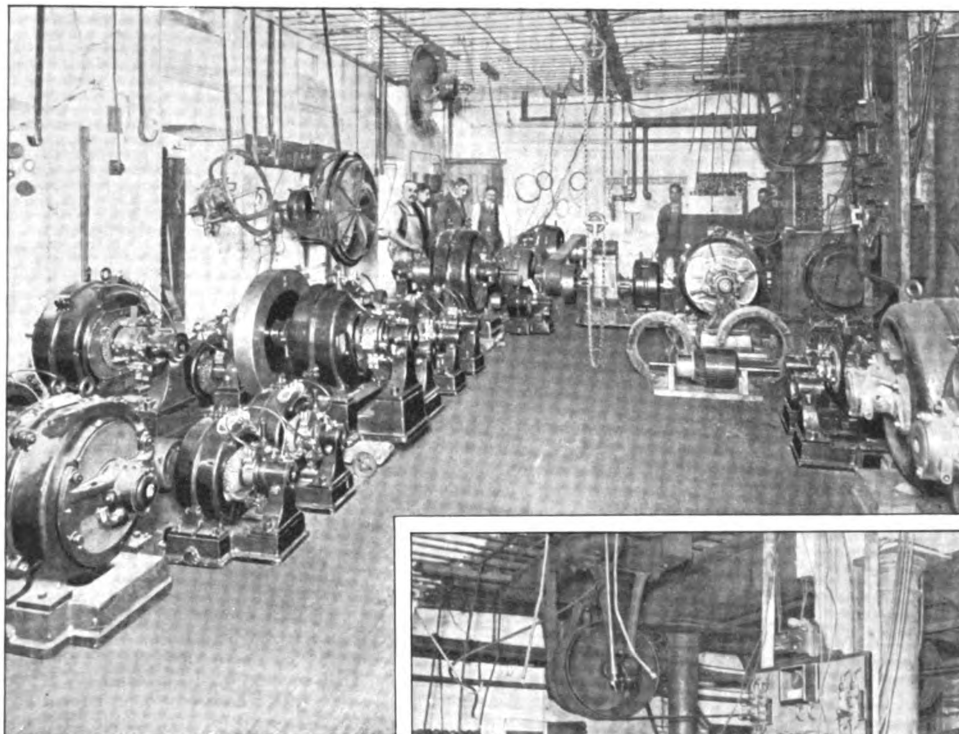
For months together this system has been on trial, and, the present tendency towards underground work bids fair to give it a prominent place in the railway art.

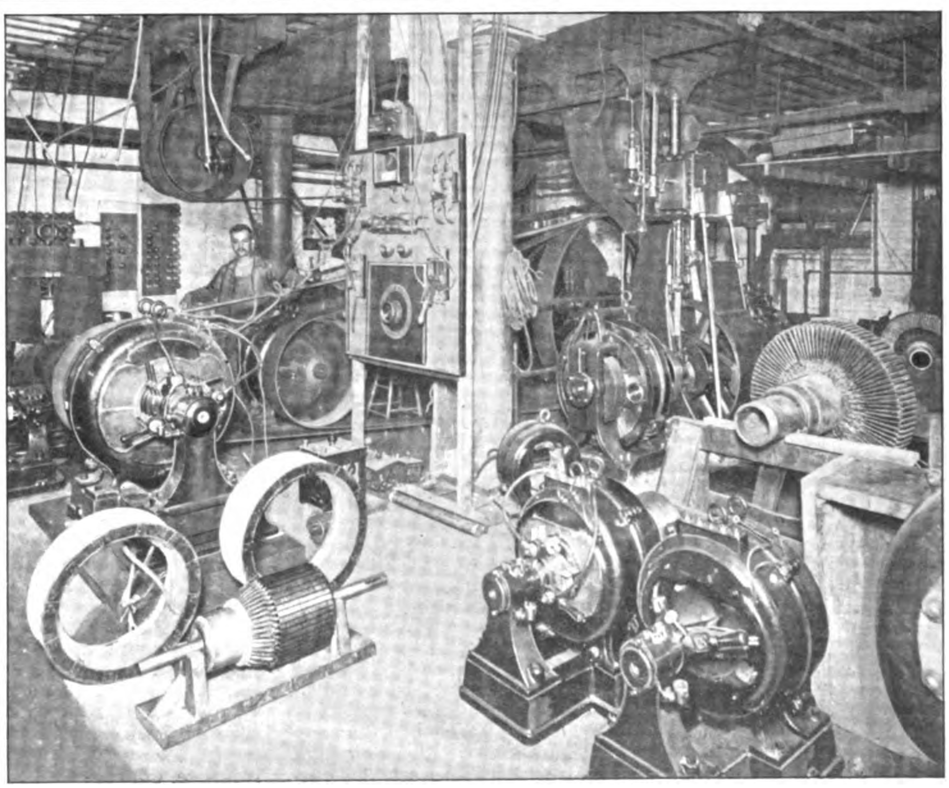
XII.

These things, numerous, complex and varied, by no means exhaust the energies and resources of the Company. It is a striking fact that its work has brought it into most intimate and friendly relations with architects all over the country, with the result that its advice is freely sought. The architect has to know so much nowadays he may be excused if he does not at once and offhand, know all about electricity or electrical wiring and installation. In view of the difficulty of the work involved, the Interior Conduit & Insulation Company stands ready to furnish architects with plans and specifications for the wiring of all new buildings, and thus at one stroke relieves them of many perplexities. It is surprising to see how many architects avail themselves of the company's good offices. But this is not all. Satisfied that the good wiring propaganda could not be carried on without plenty of printer's ink, the company established a journal called the *Architects' Electrical Bulletin*, which is now in its sixth volume and which for years has steadily advocated scientific conduit work and has discussed with much ability and vigor all the questions that have arisen as to insurance, underwriters' rules, methods of wiring, etc. It has moreover become a manual of good architecture by presenting to its readers scores and scores of the finest of the new buildings that have been erected in America of late years. Such a journal going out month by month with a steady issue of 8,000 copies, and reaching an intelligent body of men like the architects has played a part of incalculable value in educating the public mind up to an appreciation of the importance of good electrical work ; while the Company has itself undoubtedly been more than recouped by the vast publicity thus given alike to its products and the principles upon which it has dealt with the leading questions of the hour, as they arose. There are a great many technical points coming up all the time about which the public wishes to be informed in popular,



Cross Section of Lundell Motor.





Department for Building Special Lundell Generators, Ship Lighting Plants, etc.

but accurate language; and this is the work that in its own special field the *Bulletin* has essayed to do with great success.

XIII.

In dealing with so vast a field of operations and with so large a range of important products, it has, of course, been necessary that the Company should be well represented in the different parts of the Union. In one sense, the agencies are territorial, but their distribution is naturally governed by the amount of new architectural construction that goes on. It has been estimated by no less an authority than Mr. Edward Atkinson, the economist, that the ordinary expenditure for housing 3,000,000 people, or the rate of increase during two normal years, is about $300,000,000, and that perhaps at any one time as many as 2,300,000 other people will be engaged in such constructive work, whether for homes or for factories and offices. The bulk of this work is done in cities, and it is an obvious sequence that in cities of great activity the agencies of a progressive electrical concern specially occupied with building will be located. The agencies of the Interior Conduit & Insulation Co. are as follows:—Thos. Day & Co., San Francisco; Mountain Electric Co., Denver; J. E. Putnam & Co., Rochester, N. Y.; Post-Glover Electric Co., Cincinnati, O.; Central Electric Co., Chicago; Southern Electric & Manufacturing Co., New Orleans; Walker & Kepler, Philadelphia; Electrical Supply & Construction Co., Pittsburgh; Sioux City Electrical Supply Co., Sioux City, Ia.; Frazar & Co., China and Japan; Pettingell-Andrews Co., Boston; Western Electrical Supply Co., Omaha; Southern Electrical Supply Co., St. Louis; Gate City Electric Co., Kansas City; McKay-Howard Engineering Co., Baltimore, Md.; Old Dominion Electrical Construction Co., Richmond, Va.; and W. T. M. Mottram, Dallas, Tex. The interior conduit pipe line is evidently quite complete in its ramifications and distributing points.

XIV.

The officers of the Interior Conduit and Insulation Co., with headquarters at 527 West Thirty-fourth street, are Edward H. Johnson, president; Everett W. Little, vice-president and general manager; Chas. P. Geddes, secretary and treasurer; Robert Lundell, electrician, and Chas. S. Pease, superintendent. The board of directors is a representative body of men, comprising E. H. Johnson, Henry Steers, Allan C. Bakewell, Col D. Tows, Carl Schurz, John Markle, Josiah C. Reiff and E. W. Little.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRICITY OR STEAM?[1]

BY H. G. PROUT.

Editor of "The Railroad Gazette."

We are told that when Madame Roland bared her fair neck to the guillotine, she exclaimed, "O Liberty, how many crimes are committed in thy name!" The discriminating observer of modern affairs must often be tempted to say, "O Electricity, what follies are uttered in thy name!" Day by day the wonders multiply. Within a month, for instance, we have been told of an electric mail car which will weigh forty tons; will be propelled by electricity on an elevated track between New York and Chicago; will pick up and drop mail bags as it goes, and will make the run in five hours, or, say, at 200 miles an hour. This road, with its equipment complete, will cost only $10,000 a mile. When we remember that the Lake Shore and Michigan Southern is capitalized at $102,000[2] per mile, the Pennsylvania Railroad at $477,000,[2] the Erie at $326,000,[2] the New York Central and Hudson River at $205,000,[2] and all the railroads of the United States at $63,421,[2] we may see at once what a tremendous saving can be made by the use of electricity, under the patents of an unknown inventor "out West," who probably never built a ten-horse-power motor in his life, and who could not design the machinery to propel a street car fifteen miles an hour to save his neck from the halter. But so long as he speaks in the name of Electricity he can get all the free advertising that he wants, and sell his stock. To be sure this is an extreme case; but from month to month we hear of the double-track, elevated electric railroads between New York and Washington, and New York and Chicago.

Within three years a double-track electric railroad, to run between Chicago and St. Louis in an air line, at one hundred miles an hour, and to do through business only, has actually been carried to the stage of doing a little grading and selling stock; and there it has stopped. It was shown that no terminals had been secured in either city, and that a railroad to live by very fast through business, without capacious terminals that could be run into at speed, might as well be built in Arizona. It was shown that there was not enough through business demanding a speed of one hundred miles an hour to pay working expenses, to say nothing of interest. It was admitted by all electricians who had proved their knowledge of their art by actual, responsible work, that motors capable of developing the power called for in the work contemplated in this railroad had never been built. While many claimed that they could be built and that they knew just exactly how to build them, no one pretended that any such motor had ever been proved in actual use. Electricians of the same class admitted that the problem of taking off the current required to do the work contemplated, at the speeds contemplated, had never been solved. Indeed, we may say that to this day, in spite of great inducements, these questions of the powerful, high speed motor and of taking off the current to run it are still open, although many of us hope that the answer is near at hand. In spite of all these facts, the stock of the St. Louis Chicago, hundred-mile-an-hour electric railroad was sold; and to-day some one is richer and many are poorer, and the road is no nearer being built than it was three years ago.

Such are some of the delusions, nursed by honest enthusiasts and designing knaves, to the waste of good money and energy. With the hope of saving a little of this waste, I have undertaken to state briefly, and as simply as I can, some of the probable uses of electricity as a motive power for railroads and some of its limitations; but I must warn the reader at the outset that I am going to write of things which are still so little matters of accomplished fact that no man living can say the final word about them unless he is a prophet.

To begin with, let us disabuse our minds of the notion that because electricity is swift and subtle and invisible, it can make a train go faster than it can be driven by steam, and cheaper. Electricity is but one of the manifestations of the energy of the sun's rays as stored in coal, or in water that has been raised to a height. It cannot make wheels turn around any faster than can steam or falling water. So far as we can now foresee, where it is used in large work it must be as an intermediary for the transmission of the energy developed in steam and falling water to the moving mechanism, and economy can be realized in so using it only in special cases. The whole question is one of economy and efficiency.

Having accepted this fundamental fact, let us see if we cannot get at a general principle that will be useful.

To haul a fast and heavy passenger train we must have a locomotive that can develop about 1,200 horse power, and this we can buy for, say, $10,000. The stationary boiler and engine, the dynamo and motor to develop in the electric locomotive 1,200 horse power will cost $75,000 or $80,000. We must add further the cost of conveying the power from the central power station to the motor on the track. This sum cannot be estimated in a general way. It would be large for long distances and great powers, and small for short distances and small powers. We see then, at the outset, that the interest on the difference in first cost in a 1,200 horse power steam locomotive and of a 1,200 horse power electric locomotive would be more than the entire fuel and wages account of an average steam locomotive. It would be impossible for the electric locomotive to save the difference in interest on first cost if it saved *all* the fuel burned and *all* the wages of the runner and fireman. It is obvious that where a certain work can be advantageously done by one 1,200 horse power locomotive the electric motor cannot compete. If, for instance, our work is to take heavy train loads of passengers, at intervals of an hour or two, and carry them ninety miles in two hours the steam locomotive can do the work much cheaper. But if our work is to take up passengers at any point on a line fifteen miles long, and at any moment, and to carry them any short or long part of that fifteen miles at about fifteen miles an hour, it will be advantageous to divide our 1,200 horse power among

1. *New York Independent*, June 6, 1895.
2. These figures are from the Interstate Commerce Commissioners' Reports, and are for main stems only—not for systems.

numerous small trains passing any given point every two or three minutes. For such subdivision the electric motor offers great advantages. The motor itself, that is the machine which actually runs on the track, is cheaper and simpler than the locomotive; it can be handled by one man at wages not higher than those of the locomotive fireman, thus saving entirely the wages of the engineman, and the cost of repairs will be less than those of the steam locomotive, how much less we cannot yet tell. It is cleaner, quieter and handier.

Thus we have a suggestion of the general principle that when the work can be massed in a few heavy trains direct steam will be better; where the work must be done in small quantities and very frequently it will be advantageous to transmute the energy of the steam into electricity. Now let us proceed to apply this suggestion of a principle to groups of cases.

At the outset let us agree as to a few definitions. I shall use elevated railroads as meaning railroads in cities, like those in New York and Chicago; and what is said of them will apply equally to underground railroads, except that in underground railroads we do not have to consider the strength of the structure which carries the track, and we do have to consider ventilation.

As suburban railroads I shall class those serving regions around large cities, and covering the zone within which men may live and still do regular daily work in the city. Perhaps twenty miles may be taken as the radius of this zone. This same class of railroads will include those connecting large towns not more than twenty miles apart, or what are often called interurban railroads.

By country roads I shall imply roads serving the smaller towns, running out into regions not very thickly peopled and connecting two or more small towns.

Main line roads will include the great mass of the steam railroads designed for general railroad business, and covering longer distances than, say, thirty miles.

For elevated railroad work electricity has many advantages, and experts are now almost unanimous in saying that it will be the power used in such work. The machinery by which a train is hauled can be so subdivided that little weight need be put on the track under any given pair of driving wheels. To haul a train of a certain weight at a certain speed we must have a certain weight in the motor, whether it be a steam locomotive or an electric motor; but in the steam locomotive the weight must be concentrated in a short length of track. The electric motor permits of spreading this weight out almost indefinitely. The result is that a lighter and cheaper structure may be used. Great stress is laid on this point by many engineers. I think that too great stress is attached to it, and that for fast and heavy elevated railroad work, structures in the future will be made heavier than they have been in the past, whatever motive power is used on them. The structure must be heavy enough not only for the weight and shock of the driving wheels, but to resist the shock due to the sudden and heavy application of brakes for quick stops. It must be heavy enough to be rigid and to be durable. There appear to be very sound reasons for believing that it would be a bad investment to build in any city an elevated railroad not adapted for fast and heavy work. Generally speaking, no comparatively inefficient elevated railroad is likely to pay interest on the investment. The cost of the structure itself is only one of many elements of the cost of such a railroad, and a small addition to the cost of the structure makes but a small percentage of the total cost and will add greatly to the earning power. Therefore the idea of building light and cheap elevated railroads in cities is probably a fallacy, and the mere item of reducing the weight on driving wheels, in order that a light structure may be built, is not so important as it seems to many engineers. If you have a light structure already built you can make it carry a few more passengers by using electric motors.

A really important advantage for this kind of work is found in the cleanliness of the electric motor. It emits no smoke or gas, and blows out no cinders to foul sidewalks and houses. This of itself, all other things being equal, would decide the question in favor of the electric motor. Probably there is a much stronger reason for the use of electricity in this special work—it will be cheaper. This is still mostly a matter of theory. Experience so far with electric motors for elevated railroad work is very limited, and while economies are probable, they are not proved. It is easy, however, to figure out theoretical economies, and the greatest probable economy will be in fuel.

It is doubtful if any less coal will have to be burned to propel elevated railroad trains by electricity than by steam, but cheaper coal can be used. While coal can be burned with greater efficiency under stationary boilers than in a locomotive, yet the losses between the boiler and the driving wheels are so much greater with the electric machine that in the end it is probable that no saving in tons of coal will be realized; but generally a material saving will be made in the price of coal burned. Elevated railroad locomotives must use good, clean anthracite coal. This is vital. They cannot be permitted to foul the air of cities with the black smoke of bituminous coal. Bituminous coal, however, of a very ordinary quality can be burned at the central power stations without making a nuisance. Here will come in a saving. For instance, anthracite coal costs on the locomotive in Chicago about $7 per ton. A good bituminous steam coal can be delivered there in the boiler house for $1.75. The differences in New York City would not be so great, but still great enough to make economies.

Another possible economy, a small one, is in the wages account. The electric motor is a very simple affair, and can be driven by one comparatively low-priced man. The steam locomotive requires one high-priced man and another one whose wages must be about as high as those of an electric motor man. Thus in each train run the wages of the locomotive engineer can be eliminated by using electric motors. It is true that very sensible men hold that fast, heavy, elevated railroad trains must never be run with one man on the motor at the head; that for security there must be two men to guard against the accident that would arise from the sudden disability of one: but till laws are made requiring two men on the motor, I doubt if railroad managers will believe that two men at the head of the train are necessary to reasonable safety; and, after all, we must not expect to get unreasonable safety at reasonable prices. Safety, like everything else in the world, is a commodity to be bought and paid for.

It is probable, further, that economies will be realized in the maintenace and repairs of electric motors, for the machine is much simpler than the locomotive. This, however, is still a matter of conjecture. The art is so young that we cannot yet tell where the average figure for repairs to electric motors will settle down.

There is still a further advantage in electricity for this sort of service. Instead of using a locomotive simply to haul the train the motor car can also carry passengers, and the weight of the passengers will be available for adhesion; that is, the dead, or non-paying, weight of any given train will not be quite so much. This will be an element of economy, and the whole tendency now in designing the equipment for elevated railroads is to abandon the electric locomotive and to use electric motor cars.

For surface railroads in cities there is no question as between the two systems of propulsion. Nobody thinks any longer of using the steam engine there, except in a few small towns where so-called dummy roads still exist. But the steam dummy is destined to disappear, as must the horse, the mule and even the cable, before the greater efficiency of the electric motor. For street work the electric motor is almost ideal; it is clean, handy and wonderfully flexible. The motorman can run as slowly as he pleases, stop quickly, and when he sees an open bit of road in front, speed up to the greatest capacity of his machine. Thus this power fills the essentials for street railroad working. The fact that many people are slain by the trolley cars is no fault of the agent used to propel them; it is merely a question of intelligent control. But people must not expect to get high speeds through crowded streets and safety at the same time; the two things are absolutely incompatible; no human power can reconcile them.

The conditions in city streets and the conditions of suburban working merge into each other, and many of the reasons for the use of electricity in one case hold in the other. We have seen that there are certain mechanical reasons why the highest economy in electrical working is to be reached in a service that demands very frequent trains, frequent stops and not very high speeds; and these are the conditions found in all city railroads and on suburban railroads to moderate the distances out. We may say that the electric motor is destined to replace the steam locomotive for suburban service within a radius of about twenty miles of the business centers of the great cities. Twenty miles is only a rough approximation; this radius may become a little longer or a little shorter. On the whole, I am inclined to think that for a good many years the tendency will be to make it less than twenty miles rather than more.

In this class of roads I have included also those connecting cities and large towns. The development of the roads of this class has only begun, but it has already shown great possibilities. Perhaps the most remarkable case is that of the Twin City Rapid Transit Company, working in and between St. Paul and Minneapolis. A few years ago two different steam railroads were running, hourly, interurban trains between those cities, besides many through trains which serve the interurban passengers.

An electric railroad was built from one city to the other, and within six months both the steam railroads discontinued entirely their interurban trains. The reasons are plain, and the case is typical. The electric cars run every six minutes; they pass right through the streets of the cities; they stop anywhere; they charge but ten cents fare, and give transfers to the urban trolley lines. The steam railroad trains ran at little less than half-hourly intervals (counting both railroads); one could take the trains only at the stations, and the lowest fare was fifteen cents, and to get this rate one must buy a fifty-ride trip ticket. The distance is about ten miles in each case. The single fare is thirty cents, and the round trip fifty cents. So, while one can go from the station in St. Paul to that in Minneapolis in twenty-five minutes by the steam railroads, and while it takes

fifty minutes to make the trip by the electric cars, the latter have taken the mass of the interurban business. This is not merely a question of fares; it is also largely one of convenience. The slower time of the electric cars is more than made up by the convenience of taking your car any time and anywhere. In such service as this the the electric railroad is very efficient, and is sure to beat the steam railroad.

But in longer distance suburban and interurban business the conditions change, and in this field many promoters and investors will meet bitter disappointment. At some distance speed becomes more important than frequency, but speed introduces all the costly conditions of steam railroads. It will be observed that the St. Paul-Minneapolis electric railroad runs ten miles at the rate of twelve and a half miles an hour. To do this a maximum speed of twenty miles an hour is reached between stops. For a suburban distance of twenty miles we must expect to make thirty miles an hour from terminus to terminus, which means, if there are many stops, forty-five miles an hour at least between stations. Of course these figures are only approximate, but they are near enough to the truth to illustrate the point. But forty-five miles an hour means track, and rolling stock up to the grade of good steam railroad practice; it means also a fenced track on private right-of-way. Society will not tolerate such speeds on the public highway. Furthermore, recent court decisions indicate that railroads running from town to town cannot much longer be regarded as "street railways," privileged to occupy the highways without cost; but that they must secure their right of way as do steam railroads, compensating the owners of the land. So it will come about that electric surburban and interurban railroads for moderately long distances, and able to give the same service as steam railroads, will cost quite as much. For reasons given in former paragraphs of this article they may cost more to build and to work. Each case must be carefully studied on its own merits.

For the service of small towns there is a field that the electric motor can fill better than the steam locomotive or the horse. This is the field for what I have called country roads. They can be lightly equipped, laid on common roads (till the law drives them off), and worked at moderate speed; and they should carry not only passengers, but mails, express matter and light freight. But let the investor beware even of these. They are dangerous, and each case should be carefully studied.

Finally, we come to the use of the electric motor on main lines of railroads. I have already shown why it cannot compete with the steam locomotive when the traffic can be massed in heavy trains at considerable intervals. Some day in the distant future higher speeds may be required on a few lines than will be possible with a steam locomotive. The limit of locomotive speed will be found in the capacity of the fire box and boiler that can be carried. Then special high-speed lines may be built between some of the great cities on which electric motors will be used, into which can be poured the unlimited power that can be generated in central stations. Such a railroad could not live under existing conditions. It would ruin its owners. But future generations may see it.

ELECTRIC TRACTION IN JAPAN.

It is stated that in addition to the Kyoto, the first opened in Japan (March 21, 1895), another road is to built between Kobe and Amagasaki, a distance of fifteen miles.

TROLLEY TRACK BUILDING IN DETROIT.

Manager Everett, of the Detroit Railway, proposes to lay some tracks in Detroit according to the English plan of building railroads. That is, to lay the rails on concrete without any ties, and bind them together by tie rods connecting the rails every ten feet. Cement is placed around the bottom of the rails and the pavement laid on top of it. Mr. Everett laid ten miles of track in that style in Canada and says it works to perfection. The rails he uses are seven inches high. Two inches of the height at the bottom of the rail would be imbedded in concrete. The remaining five inches would be covered by the brick of the pavement.

MILWAUKEE STREET RAILWAY REORGANIZATION.

The plan promulgated for the reorganization of the Milwaukee Street Railway property provides that bondholders shall take preferred stock for 87½ per cent. of their holdings of bonds. To furnish new capital for construction $1,000,000 new bonds and $1,000,000 new preferred stock will be issued. It is figured that the reduction in bonds will lessen the fixed charges $100,000 per annum.

The Kingsbridge Franchise recently awarded the Third Avenue road is being attacked, in behalf of the Metropolitan Traction Co., which offers greater facilities and a fat bonus.

IS A SHORT TRIAL SECTION A VALID TEST OF AN ELECTRIC RAILWAY CONDUIT SYSTEM.

BY W. L. HEDENBERG.

During these, the pioneer days of the electric conduit system, it might be in place to consider the value of short trial sections, in determining the practicability of a system. During the past few years and especially after the Metropolitan Traction Company offered that fifty thousand dollar prize, innumerable people seemed bent on solving the problems of the electric conduit railway. For a short period inventing systems seemed to be the rage and, strange to say, not merely among engineers, but with lawyers, doctors and business men. In consequence the Patent Office in Washington was kept busy trying to straighten out infringements. About one hundred electric conduit railway systems were patented in the United States during 1894, and undoubtedly many more were invented without being patented. These latter no doubt infringe more or less on the thousand or more already patented. Some of these systems are exceedingly ingenious, but by far the greater majority are altogether too complicated for practical use.

Up to the present time but two or three of these systems have been tried on a large scale, by far the greater majority built being short trial sections of a few hundred feet in length. These short sections were constructed by companies formed to handle some one or other of the numerous patents. A car is usually kept in readiness and reporters or visitors are ridden around and shown the modus operandi of the mechanism. In some cases the conduit is purposely flooded with water, to show that the system would work under the most unfavorable circumstances. In this way persons are induced to purchase stock in the company or prevailed upon to make some arrangement in regard to the use of the system.

These few hundred feet undoubtedly show that as far as the mechanical part of the system is concerned it is all right, for if it were not the car would certainly not run. On the other hand it is not necessarily proved that because one car runs well on a line, say, six hundred feet in length under very unfavorable circumstances, that a number of cars will run well on a line several miles long under ordinarily bad conditions.

As every one is well aware, no insulator or dielectric is absolutely perfect. The resistance of dry air, probably the best known dielectric is overcome by atmospheric electricity. Some current will force its way through an insulator, no matter how perfect the latter may be. The amount of current lost in this way will depend chiefly upon the voltage. At a low pressure, say, three hundred volts, the amount of current forced through a dry insulator would be inappreciable, while with a high pressure, such as an arc electric light circuit the amount of current lost, especially if the insulators are slightly damp, is greatly increased although still very small; considerable current is lost through leakage in very damp places. This is especially noticeable on overhead lines just before a rain. As soon as the rain begins the amount of current lost is less, no doubt due to the breaking up of the continuity of the particles of moisture.

Assuming the resistance of a dry insulator at 25 megohms, the amount of current then lost on a line having a pressure of 500 volts through one insulator would be:

$$\text{Current lost} = \frac{500}{25,000,000} = \frac{1}{50,000} \text{ ampere,}$$

an amount too small to be taken into account.

Now taking the case just mentioned where a section six hundred feet in length equipped with one car, was flooded with surface water. The latter, naturally impure, would have an exceedingly low resistance. The insulators in the conduit becoming wet would have a much lower resistance than formerly.

Supposing the resistance of the insulators to drop from 25 megohms to 1000 ohms. The loss of current at each insulator would then be

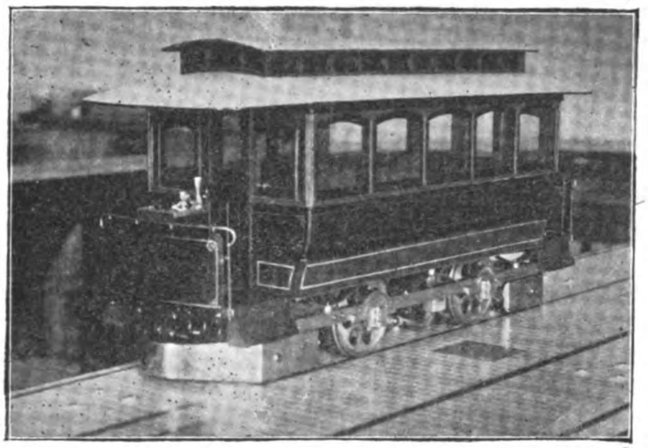
$$C = \frac{500}{1,000} = \frac{1}{2} \text{ ampere.}$$

With fifteen insulators in the section the total loss would amount to $\frac{1}{2} \times 15 = 7\frac{1}{2}$ amperes. With 396 insulators the loss would amount to 198 amperes, an amount of current equivalent to that required to start four cars. In order then to keep as many cars running under unfavorable conditions, as were run in dry weather, a company would have to provide feeders, at great expense. It is just at this point where the question, whether a road will pay, comes in.

The short section under the most unfavorable circumstances appeared satisfactory and practicable, but when a road several miles in length is considered the loss of current under unfavorable circumstances may be so great as to force the company to stop running more than half their cars or to continue running them at an enormous outlay of capital on which dividends may not be paid for years.

WESTINGHOUSE CONDUIT RAILWAY SYSTEM.

There is now on exhibition in the offices of the Westinghouse Co., Equitable Building, New York, a model car and underground railway system intended primarily for city traffic, but which it is also proposed to use if necessary, in the equipment of the New York Elevated railways with electric power. The model which we reproduce in the accompanying engraving, represents with some modifications the system operated during the past winter in Washington by the Electro-Magnetic Traction Co., which owns the Wheless patents. It has been illustrated in The Electrical Engineer, a stretch of road three quarters of a mile in length being laid on North Capitol St. In this system the live conductors are laid below the surface of the street and con-



Model of Westinghouse Conduit Railway System.

nect to triple-point contacts on the street surface, through the medium of automatic switches. As the car comes over the three-point contacts, a storage battery carried on the car energizes the underground switches and throws the main current on to the triple contacts to which a bar carried by the car makes contact. When the bar passes off the contact points the switch breaks the circuit to the feeder and the triple contacts remain dead.

A system of this kind is now in operation on the yard tracks at the new Westinghouse Works in East Pittsburgh, and was inspected by Col. Hain and Mr. Frank J. Gould, on their recent tour of inspection looking to the equipment of the New York elevated railway with electric motive power.

INTEREST IN SIEMENS & HALSKE CO. SOLD TO C. T. YERKES.

A special dispatch of June 16 from Chicago says:—

Charles T. Yerkes and the Eastern capitalists associated with him in street railway and other enterprises are said to have secured a controlling interest in the Siemens & Halske Electric Company of America. This company has just purchased the extensive plant of the Grant Locomotive Works, in the town of Cicero, where it moved after being burned out last year. The business will be expanded into one of the largest manufacturing plants of the kind in the country.

In order to make this purchase and enlarge its business the company found it necessary to increase its capital stock from $1,000,000 to $2,000,000. With this increase the control of the Siemens & Halske plant passes from Europe to America. The Grant Locomotive Works Company receives for its plant $500,000 in common stock and $200,000 in preferred.

The reason for the Yerkes syndicate deal is said to be that they want an electric plant which can be utilized to manufacture electric motor machinery for their street railroads as a substitute for the present motive power. In New York, Pittsburg, Philadelphia and Chicago, besides other cities, they control a majority of the transportation lines. In a few weeks the Siemens & Halske force will be increased from 500 to 2,500.

WELCOMING THE DEADLY TROLLEY AT MANCHESTER, N. H.

A special dispatch from Manchester, N. H. of June 9, says:— The first electric car ever run in Manchester was started just before midnight last night, and ran the entire length of Elm street. The street was crowded with people, who cheered enthusiastically. The car was filled with the officials of the road, city government people, newspaper men and prominent citizens. The electrics will not begin running regularly till July 1.

TO RUN THE NEW YORK ELEVATED BY ELECTRICITY.

The days of steam on the New York Elevated system appear to be numbered. The following special dispatch appeared in the New York papers on June 14:—

Pittsburgh, June 13.—The *Times* will say in the morning that an alliance has been consummated between the Goulds and the Westinghouse people in electrical affairs against the Vanderbilts and the Edison General Electric Company.

The contract for the electrical equipment of the Manhattan Elevated Railway of New York has been awarded to the Westinghouse Electric Company of Pittsburgh. It covers between six and seven millions of dollars.

The first official announcement of the fact was given out to-night when F. K. Hain, Vice-president and General Manager of the Manhattan road, and Frank J. Gould arrived in this city to go over the Westinghouse works and examine the system of motors and appliances. Mr. Hain said:—

"Electricity is the power of the future in our business, and we must keep up with the times. It's not true, as has been reported, that the Edison General Electric Company is to furnish the Manhattan Elevated road with electrical equipment.

"The contract for that work has been given to the Westinghouse Electric Company. It will involve between six and seven millions of dollars' worth of electrical apparatus. It will not mean a change in our roadway, but will give us a much cheaper system of operation than that in use at present.

"Locomotives of 200 horse power will be used and the cars will be heated and lighted by electricity."

The following special dispatch of June 14 appeared in the evening papers of that day:—

Pittsburgh, June 14.—F. K. Hain, Frank Jay Gould and William Northrop of the Manhattan Elevated Railway Company went out to Brinton and Wilmerding to-day to inspect the plant of the Westinghouse Electric Company, in connection with bids for an $8,000,000 contract for appliances and supplies. They deny the report that the contract has been let to the Westinghouse Company. F. K. Hain, speaking for the party this morning, said:

"There is not a particle of truth in the report that the Manhattan Elevated Railway Company has let this big contract to the Westinghouse people. The contract has been let to no one, and we are not even prejudiced in favor of the Westinghouse Company and against the General Electric. We have asked for bids, but the matter has gone no further. Our purpose in coming here is to inspect the Westinghouse plant, that we may be fully informed in connection with the bids."

At the New York offices of the General Electric Company it was stated that the reported signing of the contract for the equipping of the Manhattan system with electricity was incorrect. It was further intimated that the General Electric Company had been and still was a party to the negotiations. If their offer should be accepted, the equipping of the road would, it was said, take about a year, but would offer no obstruction to traffic. The cost to the Manhattan Company was placed roughly at about $7,000,000.

A prominent official of the Westinghouse Company in New York said: "The statement that a contract has been entered into between our company and the Manhattan is premature. The two companies have been in conference off and on for some two years past in regard to this matter, but definite action has been deferred at the suggestion of our company pending the perfection of electric motors under the Tesla patents. The time is now about ripe for supplanting the steam locomotives with electric motors. I can say nothing more about the matter at present."

SUCCESS OF THE MT. HOLLY TRIAL TRIP.

President Roberts of the Pennsylvania announces that he and other officials are entirely satisfied with the results of the experiment made on the new electric road between Mount Holly and Burlington. Three trips were made with one trolley car and a passenger coach of the regular standard pattern. It is believed that a speed of 60 miles can be maintained without difficulty or danger. If this can be done, Mr. Roberts says, electricity will supplant steam as the motive power on the line between Philadelphia and Atlantic City.

ELECTRIC LAUNCHES AT THE ATLANTA EXPOSITION.

The contract for the operation of the electric launches on the lakes at the Cotton States and International Exposition has been let to Gen. C. H. Barney, of New York. The launches will be made of cedar, with oak frames and mahogany decks. Seven Venetian gondolas and one Venetian state barge will also be placed upon the lakes. These lakes, surrounded by terraces covered with running honeysuckle, and illuminated at night by thousands of electric lights, will be one of the most beautiful features of the Fair, and the electric launches and gondolas will afford a quick means of transit from one part of the grounds to another. Around the margin of the lakes, at vantage points, will be the landings.

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CONTENTS.

THE INDECISIVE TELEPHONE DECISION.

THE opinion of the U. S. Circuit of Appeals in the Berliner case has, at last, been handed down, and is in its way a most extraordinary example of the diversity of opinion which may be created by identical arguments. Judge Carpenter, it will be remembered, held that the Government had proved both of its propositions, which involved, first, negligence on the part of the American Bell Telephone Co. in the prosecution of the patent in the Patent Office, and, second, the non-validity of the patent, under the well-known *Miller* vs. *Eagle Mfg. Co.* decision, owing to the issuance of a prior Berliner Patent. The Circuit Court of Appeals takes exactly opposite views, holding that the proofs show that the American Bell Telephone Co. was not responsible for the delay which occurred, and if more than unusual delay be alleged, the burden thereof must indeed rest upon the Patent Office Officials, and not upon the Bell Telephone Company. This is a most extraordinary view to take of the case. While it apparently exonerates the Bell Co. from the charge of laches, it is a most severe reflection on the Government, and more particularly on the Patent Office. Announcement has already been made of the change in the rules requiring inventors to be more diligent in the prosecution of their claims, but the opera bouffe innuendo that the Patent Office was, in fact, hostile to the Bell Telephone Co., with a disposition leaning favorably toward the application of Drawbaugh ought not, we think, to be allowed to go unchallenged by the officials of the Patent Office. To some, perhaps, the proposition here put forward may appear little short of ludicrous.

Having thus disposed of the question as to whether or not the Bell Co. displayed due diligence the Court takes up the question of the prior Berliner patent, and its effect upon the patent at issue. One would have supposed that the magnitude of the interest involved would have called forth some definite expression of opinion, but the Court has fought shy of this most important point, under the plea, practically, that it has no jurisdiction in the case at the present stage of the proceedings, and in the form of the suit as brought by the Government! In other words, the Court holds that the United States itself cannot sue for the cancellation of a patent granted by its own officials, and that if the patent officials erred in issuing the patent, it was an error of judgment only, and not a mistake in law. The question, therefore, as to the validity of the Berliner patent of 1891, in view of the prior Berliner Patent, is left just exactly where it was before the Government suit was filed. This must be considered, in many respects, a very hopeful sign for the future. In avoiding entirely passing upon the merits of this part of the Government contention for the nullification of the Berliner Patent, it leaves this most important point entirely unprejudiced to be argued before another court, in a suit for infringement and by parties whose personal interests are involved. If the case be carried to the Supreme Court, which seems doubtful, it will delay final adjudication in the matter possibly for a year or more, and it is doubtful whether the American Bell Telephone Company will undertake to molest alleged infringers by application for injunctions. Should the case, however, not be certified to the U. S.

Supreme Court there is little doubt that the Bell Co. will, at once, begin an active campaign of litigation, which will probably be started by a suit brought in the Massachusetts Circuit. Possibly such a suit may be brought against a not unfriendly infringer, and if such be the case, we will probably see application made by the recently organized association of telephone manufacturers, to be allowed to intervene as co-defendants. We are more than ever of the opinion expressed in our editorial of May 22, that the telephone situation is by no means hopeless, and with Judge Carpenter's decision already squarely against the Bell Co. on the main point, the chances are in favor of this view being sustained in a subsequent suit, and of the nullification of the Berliner Patent.

ELECTRICITY FOR ELEVATED ROADS.

Closely following upon the successful equipment of the Metropolitan Elevated road in Chicago with electricity comes the announcement that the Alley Elevated road in the same city has also adopted electricity as a motive power; while to cap the climax, it is now stated that the New York Manhattan Elevated has at last reached the point of considering the subject seriously. As a matter of fact, the Elevated Co.'s. structure in New York was the chosen field for the pioneer experiments of Daft, Field and Sprague, and it should have led the van; but up to this time it has been groping in doubt and uncertainty as to what should best be done. At last its mind is made up, for although the officials deny the reports that they have already closed a contract with the Westinghouse Company, they admit the fact of negotiations and of a visit to the Westinghouse works, to size things up. Indeed, the Manhattan Company is not only in receipt of Westinghouse bids, but of one from the General Electric Company; while we happen to know that a definite proposition was made some time ago by Prof. S. H. Short in behalf of the old Short Company.

Those who are conversant with the real facts of electric railway development are not surprised at the willingness of the New York Elevated road to adopt electricity as a motive power, but only amazed at the time it has taken them to reach their conclusion. The former trials with electric locomotives by Daft and Field certainly gave proof of the feasibility of that style of equipment; while Sprague's method of equipping each car unit showed itself to be practical and operative. But neglecting from the survey such early work, it must be obvious that the demonstrations in Chicago and Liverpool would soon drive New York to a change. Moreover, the World's Fair elevated electric road, built in a hurry and operated with a trial plant, carried more than eight million people very successfully, so that there has no longer been any excuse for the retention of steam with its numerous objections. An elevated structure is, in fact, an ideal place for electric traction, and we believe it will there exhibit many qualities of unexpected economy and efficiency. Not only that, but it will be able to solve the serious problems of lighting and heating which to-day are in a most unsatisfactory condition. It will further be an element of cleanliness and health. Each of the little steam locomotives vitiates as much air as 27,000 people, and scatters gases, dust, cinders, hot water and grease all over the neighborhood. With steam gone and electricity in full play, the Elevated will not be anything but a hideously ugly structure, but it will be measurably nearer its ability to give the city swift, clean and cheap travel.

NO NIAGARA POWER FOR BUFFALO.

Since our recent editorial was written on "Buffalo Blindness," referring to the unfortunate position in which Buffalo had placed itself with regard to Niagara power, important changes have taken place in the situation, more than justifying the views we then ventured to express, and which we still venture to hold, despite the abuse, scorn, contumely and vulgarity heaped upon our devoted heads. If, as would appear, Buffalo does not care a rap whether it gets the power or not, there can be little harm in our calling attention to the strategic manner in which the problem has been solved of distributing the surplus power from Niagara by leaving Buffalo out of the question altogether. An article appearing elsewhere in this issue illustrates and describes the manner in which the capital interested in the Niagara enterprise has secured absolute control of the bustling new town of Depew, about eight miles east of Buffalo city hall, and a most convenient point en route for other active populous centres down the State. Our map shows roughly the route taken by the power line first to Tonawanda and then on to Depew. For the present and for some time to come, all the power developed at Niagara is taken up, but there can be little doubt that arrangements will be facilitated and hastened to let Depew have the two or three thousand horse power which it needs for local consumption.

No Niagara power for Buffalo, appears to be the present curious situation—a most extraordinary result for so many years of discussion, agitation and booming. It is said by at least one of the local papers that Buffalo can get along without the power, and will grow without it. This we believe to be wholly true, for Buffalo is a city of many advantages. But it does strike an outsider and well-wisher as strange that the city should not wish to utilize every means of greatness and prosperity, and should willingly see rival cities developed near its borders sustained by resources that might well have been its own. That which has given Chicago its growth and magnificence is the resolve of its people that *every* advantage should be exploited in its favor to the utmost; and Buffalo if it chose could have done the same.

ELECTRICITY FOR THE NEW YORK UNDERGROUND.

At the regular meeting of the Rapid Transit Commissioners last week Mr. Parsons, Chief Engineer, made a report as to the general manner of operating the road, its equipment and the location of stations. He recommended the use of electricity with motor cars, the running of small and very frequent trains—two, or at most three cars—on the way tracks, and of heavier and less frequent trains on the express tracks. The express stations should not be less than a mile and a half apart.

NEW OFFICERS OF THE GENERAL ELECTRIC CO.

The following are the officers of the General Electric Co. chosen at the meeting of June 12: C. A. Coffin, president; Eugene Griffin, first vice-president; J. P. Ord, second vice; E. W. Rice, Jr., third vice; H. W. Darling, treasurer; C. G. Smedberg, assistant treasurer; M. F. Westover, secretary.

TELEPHONY.

THE WESTERN TELEPHONE CONSTRUCTION CO.'S APPARATUS.

The Western Telephone Company, now claiming to be the largest independent manufacturers of telephone apparatus exclusively, have recently completed their line of various instruments and are now furnishing everything necessary to the operation and construction of the smallest private line outfit to the largest exchange equipment. Their "Western Giant A" long distance and exchange telephone Fig. 8 is an exceptionally efficient and reliable instrument. In several public exchanges these instruments have given such improved results the company claim as to drive opposing exchanges out of competition.

Their "magneto" "microphone" and "swinging arm" desk sets are also of a novel and improved design, the magneto desk set as shown in Fig. 2 being the type furnished for the Government offices at Washington.

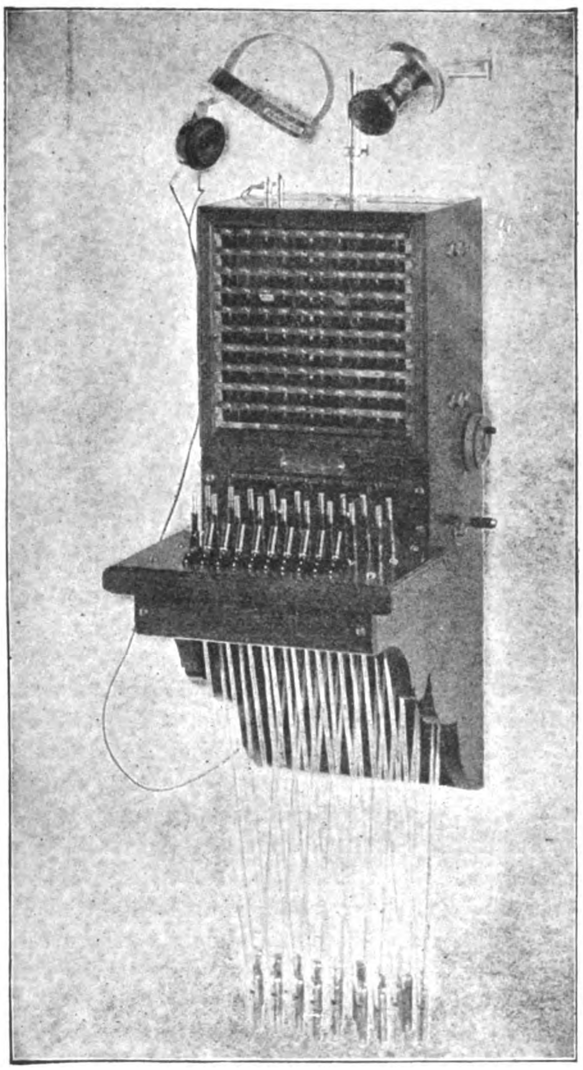


FIG. 1.—ONE HUNDRED DROP SWITCHBOARD.

In the line of switchboards, the company make five different styles. Their No. 1 board Fig. 1, is a most compact and economically operated board. Our engraving shows the board with telephone equipment, transmitter, head receiver, adjustable arm, etc.

The company now have telephones in use in every State of the Union and everywhere are giving good satisfaction. At Johnstown, Pa., a manufacturing town, where the equipment had naturally to be of the highest type, an exchange was started with 200 subscribers and within four days an additional equipment of 100 phones was ordered at Newark, O., the conditions were unusually severe, two electric railways and three lighting plants causing some of the most difficult problems in induction. A number of phones are located some six miles from the exchange and the lines for the entire distance parallel the electric lines; still no sign of induction or cross talk could be discovered.

MORE BELL STOCK TO BE ISSUED.

BELL TELEPHONE DIRECTORS declared a regular dividend last week of 3 per cent. and an extra one of 1½ per cent., payable July 15 to stock of record June 29. They also called a stockholders' meeting for June 24, to act on a recommendation to issue $1,000,000 additional stock. The outstanding capital is now $20,500,000. The new stock must be offered to shareholders at a price to be fixed by the Commissioner of Corporations, and any unsubscribed balance must be sold by auction.

QUEER THINGS IN TELEPHONE LITIGATION.

Mr. J. E. Keelyn, president of the Telephone Protective Association of America, and president of the Western Telephone Construction Co., writes us as follows:—

One of the queer things in the telephone litigation is brought to mind by the odd litigation now in progress in the Seventh Judicial District U. S. Circuit Courts.

A suit by the Thomson-Houston Electric Co. against the Western Electric Company appears to be prosecuted by the representative law offices of the Bell Company at Boston and defended by the representative law offices of the Bell Company in Chicago. Another singular fact in connection with this case is also that the counsel for the Government in the suits against the Bell Company is prominently represented with the Bell Company's Boston law office in these same suits.

The writer's judgement is that an effort is being made, not so much to defend a Thomson-Houston patent, or sustain it, as between the parties to this legal controversy, as there is a disposition to obtain a rule by this Circuit Court upon questions which will later be more greatly involved in other cases.

A prophesy may not be out of place.—In no other way could a certain adjudication by the Circuit Court of Appeals be had upon questions at issue in these first cases, unless to begin with, an unfavorable decision occurred in the lower court, as in the Boston case,—a reversal by the Circuit Court of Appeals in this Judicial District involving grave questions may be looked for and would not be surprising.

FIG. 2.

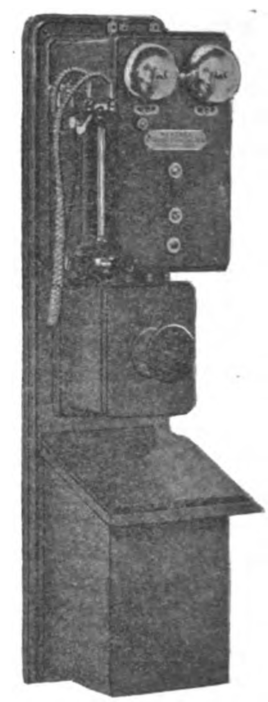


FIG. 3.

TELEPHONE NOTES.

JANESVILLE, WIS.—Telephone business has largely increased here owing to the reduction in prices.

LEAVENWORTH, KAS.—The Peoples Telephone Company is stringing six miles of wire in Leavenworth.

COLLINS, MO.—The Collins Telephone Company has contracted with A. S. Munsell to construct a line from this place to Humansville.

LANSING, MICH.—If a franchise can be secured in Lansing, a new telephone exchange will be operated there. D. A. Reynolds, well known among the farmers by his connection with the Patrons of Industry, is at the head of the scheme.

Legal Notes.

THE BERLINER PATENT SUSTAINED IN THE UNITED STATES CIRCUIT COURT OF APPEALS. —THE AMERICAN BELL TELEPHONE CO. vs. UNITED STATES OF AMERICA.

The appeal of the American Bell Telephone Co., against the decision of Judge Carpenter declaring null and void the Berliner patent on the microphone as already announced by us was decided in favor of the Bell Co., on May 18. The opinion of the Circuit Court of Appeals, covering 40 pages, was handed down on June 15 and we give below abstracts from it covering the most important points. The appeal was argued before Judges Colt, Putnam and Nelson, and the opinion was written by Judge Putnam:—

"This is a bill in equity filed Feb. 9, 1893, touching a patent issued Nov. 17, 1891, to the American Bell Telephone Company, as assignee of Berliner. The alternative prayer is that the patent be in all things recalled, repealed, and decreed absolutely null, but that, if the patent is not deserving to be wholly repealed, but is repealable in part, a decree be made repealing only such part as the court shall deem to be repealable. As to the latter part of this alternative prayer for relief, the court has heard nothing, and there is no occasion to consider it.

"Berliner's original application was filed June 4, 1877, and Patent 463,569 was issued more than fourteen years thereafter. In a general way it covers the microphone.

"The pith of the case, as stated briefly for the counsel for the United States, is:

1. That Patent 463,569 is void for illegal delay in its issue, and
2. That it is also void on the ground that the prior patent, 233,969, was granted upon the same application, to the same applicant, for the same invention."

The Court then quotes from the bill of the Government's complaint those parts relating to the allegations of delay on the part of the Bell Co., in the Patent Office and continues.

"If it were necessary to examine the methods of the company as bearing on the question of positive or implied fraud, or on a question whether it did in fact speed the application of Berliner and its purposes thereto, these facts might become relevant as evidence, as might also the alleged great value of the microphone. But it is clear that all such allegations are irrelevant to the bill itself. So far as the law is concerned the patent in suit is to be tested independently of the Bell patent. There can be but one law touching alleged delays in the progress of an application through the Patent Office, and touching the duty of applicants with reference thereto; whether the invention was from the outset seen to be valuable, or only afterward proved to be so, remains of little account. To deny this is to deny that the laws are equal, and would furnish a standard for the determination of the rights of patentees too fickle and imaginative to form a proper basis for the use of a court of law. Therefore, we have not set out these allegations as proper portions of the bill, and do not deem it necessary to make further explanations in reference to them."

Then follow extracts from the Bell Co.'s answer in defense, and of Judge Carpenter's opinion on the question of delay, and the statement of the propositions of the Government in support of its allegations.

"The United States having stated its position, we do not find ourselves required to recite the proofs. It is enough to say that the case shows that all the allegations in the answer which we have quoted are sustained, except only that we do not deem it necessary, for the purposes of this case, to determine fully the condition of the proofs on the proposition that there rested on the American Bell Telephone Company an extraordinary duty to speed its application by every means known to the law, as alleged in the bill, or to exercise the greatest possible diligence, as claimed at the bar. Unless the case required this extreme diligence there could be no just claim of an unlawful omission to act; and therefore there could not be the "unlawful purpose," because, as we have said, this does not result from a mere omission to do what the law does not require.

"During the progress of the arguments the Court anxiously looked for practical illustrations of what was meant by the high degree of diligence referred to, what practically could be done to satisfy its demands, and wherein, if accepted as necessary to relieve the applicant from the charge of a course of conduct unlawful or by implication fraudulent, it differed in its practical requirements from what was in fact done. The Court failed to receive light in this direction; and it regards it as an answer to the proposition of the United States on this part of the case, that what it did obtain was a mass of theoretical propositions, which, if applied practically, might or might not have involved the case, in its progress through the Patent Office, in greater complications and difficulties than those which did in truth surround it. In other words, so far as the proofs go, the course of the application was in accordance with the usages of that office, and was such as the officials there acting in good faith and according to their practical experience determined at the time to be on the whole the best. What would have been the practical result of the theoretical courses suggested, with an application around which centred so much powerful hostility as gathered about this one, it is impossible to ascertain by any method of determination given to the courts. If, instead of suggesting a theory as to what might have been done, the United States could have pointed out among the usages of the Patent Office an existing pathway other than that which was adopted, we would have some rule by which to estimate what could have been done in the exercise of extraordinary diligence other than was done.

"One proposition of the United States, an illustration generally of what they say might have been done, we give in the exact terms stated to us at the bar:

"'The duty of the Bell Company was to get its patent with the least possible delay by the exercise of all its legal rights. Whatever it had a right to do to expedite an application in its own interests, it was in duty bound to do in the public interest. The situation arose in which the Commissioner was not doing his duty, and in which it would have had a right to challenge his conduct in its own interest; it was its duty to challenge his conduct in the public interest. Its submission in silence to delay directed by the Commissioner in violation of his duty, was a failure in the discharge of its duty.'"

"In its own interest the American Bell Telephone Co. had a right to go to Congress for legislation touching the general course of proceedings in the Patent Office, as did the Commissioner himself in 1889. It might have applied for the removal of subordinates for the purpose of substituting others who would attempt a more radical course of proceeding. It might have applied for the removal of the Commissioner himself, and the appointment of a successor who would have turned his energies more in the direction of forwarding the application under discussion. It might have applied to the Commissioner for a general revision of the rules of practice of the Patent Office.

"The imagination can hardly put a limit to the things it had a right to do. To say, therefore, that it was bound to do in the public interest all that it had a right to do in its own, and that if it did not do this, it should pay the penalty of a forfeiture of an invention said to be extremely valuable, is a proposition so unreasonable that the mere statement of it by the United States seems to confess the weakness of their case.

"Another suggestion of a general character in this same direction was made by the United States as follows:

"'The officials of the Patent Office were guilty of gross dereliction of duty in their treatment of the Berliner application, but there is no reason to believe that anything would have been necessary to secure prompt and proper action by them except a fair, candid, full, strong, and persistent presentation of the facts by the Bell Company, with reasonably ingenious suggestions from it of ways of meeting the difficulties which were encountered in the progress of the application.'"

"This is a merely negative proposition, so far as it attempts to reach the defendant corporation, without specification and proofs. But the proposition is that there was, on the part of these officials, a gross dereliction of duty. Indeed, in the presentation of the case of the United States we have heard very much in censure of the public officials, clothed in the strongest epithets, of which we have already given some instances. We are compelled to say that if this record suggests any dereliction of official duty, it was in the form of continued hostility to the American Bell Telephone Company and of an indisposition to grant the application for the Berliner microphone, with a concurrent disposition to nurse and favor the Drawbaugh application, either for its own direct advantage or for the purpose of defeating inventions controlled by the defendant corporation. Notwithstanding, as we have already said, the proofs do not convict the officials; they show enough to have warranted the American Bell Telephone Company in guarding itself against the possibility of such a disposition on their part during the period covered by the nine years between June 9, 1882, and the issuing of the patent now in dispute. Under these circumstances, and after the American Bell Telephone Company and its solicitors had performed the customary duties with reference to the forwarding of its application, including all those things required by statute or by the Patent Office, the prompt performance of all of which is conceded by the United States, it is not for a court of law to say that that corporation, as to all the unofficial methods which it might take or might omit to take for the advantage of its case, was not entitled to use its own judgment with reference to the methods and persistency of representation to the public officers, especially those whom it had some reason to regard as unfriendly."

Regarding the lack of zeal of the Bell Co., in prosecuting the actions in the Patent Office the opinion states:

"The Court might guess that additional informal solicitations would have advanced the application, or, perhaps, have retarded it; but there is no proof which enables us to form proper judicial conclusions on this point. If the record showed that the American Bell Telephone Company had failed to make the usual communications, whether oral or written, there might be something which

the law could take hold of; but as the proofs stand, the fact is otherwise."

The Court then discusses the cases of *Planing Machine Co. vs. Keith*, 101 U. S. 479.485 and *Smith vs. Goodyear Dental Vulcanite Co.*, 93 U. S. 486 cited by the Government, and holds that the former relates to the obligations of a patentee as towards alleged infringers, and not towards the United States or the public at large. It says: "Indeed, the whole tenor of the case of the United States, so far as it is supported by the proofs, has the appearance of requiring of the defendant corporation a degree of diligence and astuteness apparently greater than that which would be expected from other inventors."

The Court then further discusses the question of diligence and cites the causes delaying patents due to the interferences of Edison and Drawbaugh, and says: "The record shows beyond question that the Berliner and Edison applications, which went hand in hand, had become so notorious that the knowledge of them permeated the Patent Office from the head to the foot, and that the contest against them by Drawbaugh was so vigorous that it was impossible that any person, from Commissioner to Examiner, should not have understood their importance. * * *

"The practical summing up of all these various suggestions (of the United States) is that the American Bell Telephone Company is in effect censured for not reforming both the practice and the officials of the Patent Office. We think this demand is without parallel or precedent; that the case may justly be stated in this form, and that, when thus put, it shows itself so revolutionary as to require the legal mind to reject it on the mere statement. * * *

"We think this is the first instance in which either the people or the King, wherever the common law prevails, has sought to revoke, by legal proceedings, on the ground of imputed or merely legal fraud, a grant of this character issued to a subject after full official knowledge of all the facts, where there has been no deceit, collusion, or corruption, and where the subject duly complied with all statutory and departmental requirements, merely because the officers in charge have been dilatory and the subject failed to use zeal in spurring them on. The law goes quite far enough in protecting the State against the acts and omissions of its agents, without our pushing it to the extreme of adopting this heretofore unheard of proposition. * * *

"The most that can be claimed by the United States is that the officials of the Patent Office, having all the law and facts before them, erred in the free exercise of their free judgment in the determination that the earlier patent did cover the invention described and claimed in the later one. Even were this so, the result was not a mistake in the sense of the law in its application to the principles of cancellation of deeds and other instruments, but it was merely an erroneous judgment and determination of the ultimate fact deducted from the primary fact, all of which were known. * * *

"As we are clear that this proposition of the United States cannot be sustained in the law, even admitting the facts to be as claimed, we will not undertake to determine the substantial identity of the respective claims of the two patents or any of them. We prefer to leave that without prejudice in the event it hereafter involves other individual or corporate rights."

Coming to the question of the right of the Government to nullify the acts of its own departments and officials in a case where no fraud or corruption can be proved the Court cites numerous cases negationing the proposition and concludes:

"We have shown that the action of the Commissioner, so far as this issue we are now considering is concerned, was merely a finding of the ultimate facts from other facts, all of which were known to be official, and the principle which we thus use in the interpretation of the statute (Section 4,893) is one of very general application. It is illustrated in numerous departments of the law, where acts are done by public or corporate officials as the result of investigation authorized to be made by themselves, none more noticeable than in the great mass of municipal and other public bonds which have been supported by the courts on the strength of the certificates of local officers, directed to make findings of the preliminary condition required by statute. We think its application to this case makes it clear that, with the possible extreme exceptions which we have characterized, the statute vests in the Commissioner of Patents authority to issue all such patents on examination he deems proper to issue; that none thus issued are issued ultra vires; that all such are within the scope of his powers, within the meaning of the expressions of the Supreme Court, and that there is nothing in this case which excepts it from this general rule. * *

"It is clear on this part of the case that we are barred from taking jurisdiction by reason of the statute provision which gives special remedies to an applicant whose patent is refused, and, passing by this, that also the issue of this patent was within the scope of the authority of the Commissioner, and that no mistake being proved, and no other equitable ground appearing, we cannot revise his action in this suit.

"The United States has filed a motion praying that if we find for the appellants we will reserve leave to the Circuit Court to permit an amendment at bar alleging that the American Bell Telephone Company did directly agree with the representatives of the Drawbaugh application, that the determination by the Patent Office of the question of priority should abide the decision in the telephone cases, that these parties, acting in concert, did procure the Commissioner of Patents to consent to such postponement, and thus that the American Bell Telephone Company, by its own act, did procure the postponement of decision of priority, without necessity or right, in violation of its duty to speed the patent for the microphone. We have already found that, as the record now stands, it contains no proof to sustain an allegation of this character. Therefore, an amendment of this nature would require the opening of the record below for further proofs.

"It is not at all a case where complainant has proved his case, but his allegations are found by the appellate court to be inapt. To grant this motion would, under the circumstances, violate all the rules requiring diligence from parties complainant.

"The decree of the Circuit Court is reversed, and the case remanded to that court with directions to dismiss the bill."

NO DELAY IN THE TESLA PATENT SUITS.

In the suit of the Westinghouse Co., against the General Electric Co., for infringement of the Tesla multiphase patents, Judge Townsend of the U. S. Circuit Court at Hartford, Conn., has handed down an order requiring the General Electric Co., to complete its proofs by October 7 next.

LETTERS TO THE EDITOR.

THE THEORY OF THE BOYNTON MULTIVOLT BATTERY.

REFERRING to my article on The Theory of the Boynton Multivolt Battery in your issue of June 12th, I would state that the local action there considered and shown to be impossible is that which is due to electro-motive forces between the different couples generated by the chemical action of the exciting fluid. In my treatment of this effect, another, which cannot be disregarded in making the theory complete, was unintentionally overlooked; that is, the effect due to the pure shunting action of the liquid considered as a conductor only. The paths along which the several differences of potential tend to produce shunt currents are well shown in the diagram of Prof. H. S. Carhart in the same issue of your paper. An inspection of them will show, however, that it is impossible for such currents to flow from couple 3 to couple 2 or from couple 2 to couple 1, because the difference of potential tending to produce them are equal and their directions of flow, through the opening in the carbon cup of couple 2, are mutually opposed. It will also be seen that the effect of the difference of potential tending to produce a shunt current from couple 3 to couple 1 is greatly reduced by the counter electromotive force, due to chemical action, acting along the same path.

J. OLIVER JOHONNOT.

MARRIED.

MARRIAGE OF MR. ARTHUR D. NEWTON TO MISS HYDE, OF HARTFORD.

There is no better known nor more popular gentleman in the electrical business than Mr. Arthur D. Newton, who, as is well known, has been identified with the Eddy Electric Mfg. Co., of Windsor, Conn., from its inception. His numerous friends will, therefore, join heartily with us in extending to him sincere congratulation on the occasion of his marriage on Wednesday, the 12th inst., to Miss Gertrude Hyde, of Hartford, a young lady to whom he has been engaged for the past year. Mr. and Mrs. Newton will be at home to their friends at 363 Laurel St., Hartford, after October first.

OBITUARY.

H. C. PARMLY.—We regret to record the death of Henry C. Parmly, senior member of the real estate firm of Parmly Brothers, of Chicago, and a member of the board of directors of the Standard Electric Company from its inception. Mr. Parmly leaves a widow and a ten year old daughter, Grace, and a brother, S. P. Parmly. He was born in Painesville, O., in 1836, and educated in Ohio colleges. In 1860 he went to Paris and there formed a partnership with his cousin, George W. Parmly, and the young firm gradually built up a large and lucrative practice in medicine and dentistry. Returning to this country in 1878, he was married to Miss Hattie Sumner, and shortly thereafter located in Chicago. Engaging in the real estate business, success attended his efforts, and at the time of his death he owned valuable properties in the heart of Chicago. Though of a quiet, retiring disposition, he was a charming companion, a loyal friend, an upright, wholesome and progressive citizen.

SOCIETY AND CLUB NOTES.

THE M. I. T. SOCIETY OF NEW YORK.

The alumni and former students of the Mass. Institute of Technology, residing about New York City, held a meeting on the Roof Garden of the Central Building on June 8 and organized "The M. I. T. Society of New York." Prof. Charles R. Richards officiated as chairman of the evening and Mr. Charles A. Meade as temporary secretary. The following Executive Committee was elected; Messrs. G. L. Heins, E. D. Brown, H. S. Chase, and F. A. Pickernell. Mr. Alex. Rice McKim, of No. 106 East 23d St., N. Y., was elected Secretary-Treasurer. The committee on organization were Messrs. C. R. Richards, H. P. Barr, C. W. Eaton, E. H. Munford, F. A. Pickernell and A. Rice McKim. On account of the length of the business meeting, which followed the dinner, the paper which was to have been read by Alex. Rice McKim, Assoc. M. Am. Soc. C. E. on "Bracing of the Skeleton Type of High Buildings," was deferred until the next meeting of the Society.

MEETING OF THE ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The fourteenth annual convention of the Association of Railway Telegraph Superintendents was held last week at Montreal, delegates being present from all parts of the United States and Canada. The chair was occupied by M. B. Leonard, Vice-President of the association, in the absence of O. C. Greene, Superintendent of Telegraphs of the Northern Pacific Railway Company, who is President of the association. Among the papers read were the following: "Lessons of Responsibility," "The Trolley System and Automatic Signals," "Standard Construction of Telegraph Lines," "Uniformity," "The Social and Moral Condition of Telegraph Operators," "Storage Batteries," "The Evolution of the Telegraph," "The Michigan Central System and its Operators," and "Water Power in Connection with Electricity and Electric Locomotion in Railroading."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Since the preliminary programmes of the Niagara Falls Meeting were distributed to the members, the Convention rate of 1⅓ fare on the certificate plan, has been granted by the Central Traffic Association and the Boston Passenger Committee. This together with the concession of the Trunk Line Association covers practically all the territory east of the Mississippi River and north of Richmond and St. Louis, conditional upon an attendance of 100 who have traveled by rail to the meeting. Those who expect to attend the meeting whether members or not, are requested to send their names to R. W. Pope, Secretary, 26 Cortlandt street, New York.

There is every indication of a large and successful meeting, a great many members having notified their intention to be present.

FINANCIAL.

A STEADY, HOPEFUL MARKET.

Stocks in general were steady during the past week, with a tendency to higher prices, induced first by the governmental crop report and secondly by the activity and hardening in iron. The close of the week saw General Electric at 36 and Western Union at 93¾. Other electrical securities held their own throughout and wherever there was any marked movement, gained strength. The general situation is decidedly on the mend, street railway properties being in excellent demand, while lighting securities are all looking up.

PROPOSALS WANTED FOR FIXTURES AT LIMA, O., AND YORK, PA.

THE Treasury Department is inviting proposals until 2 P. M., June 27, 1895, for manufacturing and placing complete in the United States Public Buildings at Lima, Ohio, and York, Pa., combination gas and electric light fixtures. Drawings, specifications and blank forms of proposal will be furnished upon application to the Department. The right to reject any or all bids or to waive defects is reserved. Partial bids will not be considered. Proposals should be addressed to the "Secretary of the Treasury, Washington, D. C., and endorsed, Proposals for gas fixtures, Lima and York." Prospective bidders may obtain additional information by addressing S. Wike, Acting Secretary.

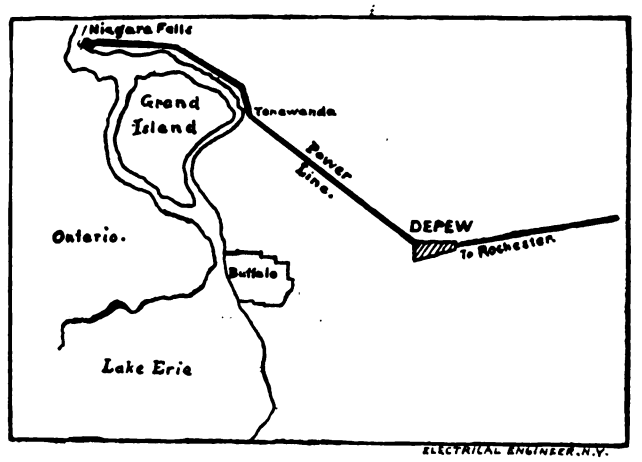
TELEPHONE ASSOCIATION MEETING.

The convention called by the independent telephone manufacturers' association will be held at Pittsburgh on June 24, and President Keelyn is issuing notices to that effect.

LOOPING AROUND BUFFALO WITH NIAGARA POWER.

AN article appeared recently in THE ELECTRICAL ENGINEER on the fact that Buffalo had done nothing yet to secure the use of power from Niagara and was in reality in danger of losing it through supineness or hostility. The article has been extensively quoted, but although its views have been attacked, its statements have not been controverted. On the contrary, the danger to which the ENGINEER ventured to point, in an attitude of entire friendliness and good-will to the beautiful and prosperous city, appears to be far more imminent than when the modest opinions of this journal were quietly set forth. Some of the largest capitalists in this country, including the Vanderbilts and Astors, have become heavily interested in the new manufacturing town of Depew, founded under New York Central auspices a few years ago about eight miles to the eastward of Buffalo. The locomotive shops, coupler works, etc., are there, and the place is springing forward with an activity that shows a strong faith in its future on the part of its sponsors. The ostensible owner of the town is the Depew Improvement Co., but, as already stated, new capital for further growth has been pledged, and the control could not possibly be in stronger hands or under shrewder management.

What adds importance to the new conditions is the fact that Depew affords a new foothold and distributing point for the Niagara power, the same parties being interested in both schemes. The map shown herewith indicates the manner in which the



MAP OF NIAGARA FALLS AND DEPEW.

Niagara Power Co. can leave Buffalo out of consideration altogether as though it did not exist; and by making Depew its second resting-place, from the Falls, Tonawanda being the first, reach out easily to Rochester and other parts of the State should it desire to do so or have surplus power for sale. The Niagara Power Co. for some time past has had its right of way bought and granted up to Tonawanda, and from that point the way to Depew is open and would offer no difficulties.

Moreover, so far from lying down idly on the supposition that Niagara power belonged to it and must come its way, without a cent being spent to secure it or help it along, Depew has been up and doing. According to recent reports in the Buffalo papers, it even stands ready to bear its half share of the expense of a pole line in order to get the power into its shops and factories. The *Buffalo Commercial* of April 9 says: "While Buffalo is dickering for Niagara Falls power and talking about impossible restrictions, Depew has made a bid for it and literally goes half way to get it. In all probability Depew will get the power before Buffalo does." This was some weeks before the vast real estate transaction above referred to—a transaction which may, indeed, have well been influenced by the attitude in which Buffalo has been placed by its authorities. The *Buffalo Express*, a well informed journal, is even more specific, and not only speaks of an agreement to transmit 5,000 H. P. to Depew, but mentions a bonus of $20,000 profferred by Mr. H. W. Box, vice president of the Depew Co.; and estimates the cost of the line at $65,000. The *Express* says: "Local capitalists interested in the development of Depew have practically closed a deal with the Niagara Falls Power Co. whereby there will be transmitted to that flourishing suburb sufficient electrical power to operate the plants of every concern now located there or projected. * * * Mr. Box was confident that there would be no hitch in the matter of securing the power for Depew at a very early date. He was of the opinion that very few restrictions would be placed on the Power Company in transmitting their power about Depew."

It will be seen from the above that a very interesting situation has developed, and that, happen what may at Buffalo, the new town of Depew has made a big bid for prosperity and a gigantic stride towards it, as a user and distributing point for Niagara power.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 11, 1895.

Alarms and Signals:—

Railway Signal, W. Daves, Jersey City, N. J., 540,641. Filed Dec. 29, 1894.

Electric Railroad Signal, B. H. Gedge, Anderson, Ind., 540,859. Filed May 20, 1892.

Conductors, Conduits and Insulators:—

Covering for Electric Wires, F. S. Randall, Philadelphia, Pa., 540,687. Filed Jan. 2, 1894.

An insulating covering consisting of straightened fibres, evenly applied parallel with the conductor.

Apparatus for Lining Tubes, W. T. Ruete, New York, 540,691. Filed Feb. 26, 1895.

Designed for the ready introduction into a piece of tubing of strips of paper or other material which is to serve as a lining and the adjustment of the same in contact with the interior surface of the pipe.

Dynamos and Motors:—

Regulation of Alternating Generators, R. M. Hunter, Philadelphia, Pa., 540,668. Filed June 21, 1894.

Improvements in the use of a counter electromotive force independent of the generating plant proper, as a means for regulating the strength of the field magnets of the alternating current generator.

Lamps and Appurtenances:—

Electric Arc Lamp, S. P. Parmly, Chicago, Ill., 540,800. Filed Oct. 26, 1891.

The carbons are made of twice the cross sectional area of the present round carbons but formed in flattened or elliptical shape.

Miscellaneous:—

Illuminated Sign or Display, P. F. Keelyn, Milwaukee, Wis., 540,742. Filed Jan 18, 1895.

The lamps are formed to the shape of the letters, each lamp having the same resistance.

Electrical Push Button, E. A. Clark, Cleveland, Ohio, 540,949. Filed Jan. 24, 1895.

Electromagnetic Combination Lock, E. & H. C. Stockwell, Stamford, Conn., 541,024. Filed August 6, 1894.

Railways and Appliances:—

Supply System for Electric Railways, O. A. Enholm, New York, 540,653. Filed Nov. 8, 1891.

A system of contacts are arranged along the road supplied by feeders and sub-feeders which are automatically connected to the contacts and disconnected after the car has passed.

Electric Railway, S. Hoeninger, Milwaukee, Wis., 540,664. Filed Aug. 15, 1894.

Designed to render the trolley wire dead upon the breakage of the trolley wire.

Electric Brake, W. B. Potter, Schenectady, N. Y., 540,685 Filed Mch. 9, 1895.

In an electric braking apparatus, a controlling switch, a brake switch, a reversing switch, an interlocking mechanism between the switches, and means arranged to vary the effect of the interlock in accordance with variations of position of one of the switches.

Trolley, W. E. Steinbach, Philadelphia, Pa., 540,883. Filed April 6, 1895.

Provides a trolley with auxiliary rollers, which serve to prevent the trolley from jumping the wire.

Conduit Electric Railway, D. Brooks, Jr., 540,900. Filed June 9, 1892

Consists of one or more chains, linked pieces or wires or other flexible material, which by their own weight rest upon the top of the wire or rail and make connection to the car.

Conduit Railway Conductor, D. Brooks, Jr., Philadelphia, Pa., 540,901. Filed Feb. 27, 1892.

Claim 1. An electric railway, having a conductor formed of two conductors with insulating material between the same, one conductor being continuous, and the other of separated sections, the conductors being connected by fusible material.

Electric Wire Lock and Support, D. W. Smith, St. Louis, Mo., 541,019. Filed Sept. 10, 1894.

A novel form of trolley wire clamp.

Conduit Electric Railway, D. W. Smith, St. Louis, Mo., 541,020. Filed Sept. 10, 1894.

Details relating to the suspension of the conductor at crossings.

Trolley Wheel and Yoke, W. H. Fritz, Dayton, Ohio, 541,044. Filed March 12, 1895.

Telegraphs:—

Electric Circuit, W. W. Alexander, Kansas City, Mo., 540,620. Filed March 24, 1890.

Arrangement of circuits by which the local battery circuit is closed alternately through the sounder electro-magnet and through a second electro-magnet so as to give to each of said electro-magnets, separately, the full force of the battery, and also to allow the sounder or receiving instrument to be cut or switched in or out of the local circuit without interfering with the operation of the sounder.

Automatic Electric Railway Signal, W. Daves, Jersey City, N. J., 540,642. Filed Feb. 14, 1895.

Photo-Telegraph, C. Willoughby, San Francisco, Cal., 540,772. Filed Nov. 3, 1894.

Relates to a system for reproducing maps, diagrams, pictures, &c., at a distance by the employment of a system or code of signals.

Telegraphic Apparatus, L. Boudet & P. Lacombe, Lumel, France., 540,899. Filed Oct. 20, 1894

A dial telegraph adapted for use in transmitting culinary and service orders in cafes, theatres, restaurants, hotels, etc.

Multiplex Telegraphy, D. B. Grandy, St. Louis, Mo., 540,974. Filed Dec. 17, 1894.

Designed to prevent the armature of the neutral relay at the receiving end from falling away from its front contact during reversals of current at the sending station.

Telephones:—

Telephone, W. W. Scott, Buffalo, N. Y., 540,761. Filed March 4, 1895.

Provides against the language of the person using the transmitter being understood by the bystanders.

Telephone Transmitter, D. Drawbaugh, Eberly's Mill, Pa., 540,781. Filed Feb. 16, 1895.

Details of construction embodying carbon granules placed between electrodes attached to a diaphragm which bears against a body of felt.

Telephone Transmitter, D. Drawbaugh, Eberly's Mill, Pa., 540,959. Filed Feb. 23, 1895.

Details of construction of a granular carbon transmitter.

Carbon Holder for Telephones, D. Drawbaugh, Eberly's Mill, Pa., 540,960. Filed Feb. 21, 1895.

A combined dampener and carbon holder, of sponge or other suitable spongiform, that is, soft, elastic and cellular non-conductive substance.

Telephone Electrode, D. Drawbaugh, Eberly's Mill, Pa., 540,961. Filed Feb. 21, 1895.

Relates to the construction of a granular carbon electrode.

Telephone, S. D. Field, Stockbridge, Mass., 540,969. Filed Dec. 5, 1894.

Claim 1. A magneto telephone having two independent circuit windings in inductive relation to each other, one of the said windings being in mechanical connection with the diaphragm and forming a closed circuit complete in itself, and the other being adapted for connection in a main line circuit.

Telephone Transmitter, C. Clamond, Paris, France, 541,036. Filed Mch. 20, 1895

Employs a loosely supported ball surrounded by carbon paste, the ball being in contact with the electrode.

Telephone Transmitter, C. Clamond, Paris, France, 541,037. Filed Mch. 20, 1895.

In a telephone transmitter, a pendulous electrode suspended within plastic viscid microphonic conducting paste, in combination with a vibratory diaphragm electrode between which and the suspended electrode the paste intervenes.

REPORTS OF COMPANIES.

AFFAIRS OF THE ELECTRICAL & MECHANICAL ENGINEERING CO.

The Electrical and Mechanical Engineering Company of 41 Cortland street has become involved and Judge Andrews of the Supreme Court has appointed Jonathan H. Vail as receiver for the concern on the application of the directors. The company was incorporated two years ago with a capital stock of $150,000. The liabilities are $26,441 and the nominal assets are $32,000. The most important of the assets is a contract with the trustees of the New York and Brooklyn Bridge for electric lighting of the cars, which is put down at $19,419. The claims of three creditors, the Third National Bank, $5,150, General Electric Company, $5,289, and Wallace & Sons, $918, have been secured by the above contract.

A STRUGGLE IN THE LOUISIANA ELECTRIC LIGHT CO.

A special dispatch of June 7 from New Orleans says:—The United States Electric Securities Company of Portland, Me., as a creditor and stockholder, filed an application to-day in the United States Circuit Court for the appointment of a receiver for the Louisiana Electric Light Company. This company is a huge corporation, and has practically a monopoly of the electric light and power business in this city. Various contracts, involving hundreds of thousands of dollars, are cited as having been improperly entered into with other concerns by the Louisiana Electric Light Company to the detriment of petitioners and of the Louisiana Electric Light Company itself. In order that petitioners' interests may be protected, a receiver is asked for, to conduct the Louisiana Electric Light Company's affairs, and an accounting is also asked for. It is said that this is a blow aimed at the Fort Wayne Co. by General Electric interests.

BONDS OF THE BOSTON ELECTRIC LIGHT CO.

The Boston Electric Light Company's first consolidated mortgage 5 per cent 30-year gold bonds, to the amount of $165,000, which Paine, Weber & Co. of Boston, are placing are part of a lien on the valuable real estate owned by the company, as well as its other property and franchises now owned or hereafter acquired in Boston. The whole issue of firsts aggregates $1,250,000, of which $300,000 are reserved to pay off bonds maturing in 1908, $195,000 have been sold and the proceeds applied to underground construction, $590,000 remains in the treasury for future use, and the $165,000 now being offered are to be used to reimburse the company for outlays recently made in underground construction. These bonds are issued with the consent of the Massachusetts Gas and Electric Light Commissioners. The company is expected to earn $193,000 net in 1895. In 1894 it earned $177,084. The entire interest charges are about one-fifth of the net earnings now, and when all the bonds are issued will be about one-third, or $65,000, without allowing for any increase of business. The company has paid 8 per cent. dividends for the last three years, and 6 per cent, for the preceding five years. The bonds have been listed on the Boston Stock Exchange, and are offered at 102 and interest.

EDISON EARNINGS IN NEW YORK CITY.

Treasurer Williams issues the following statement of comparative earnings for May.

Edison Company Only.

	1895.	1894.	
Gross.........	$120,586.50	$98,344.95	$22,241.55 Inc.
Net...........	63,596.27	46,864.93	16,731.34 "

Five Months.

Gross.........	$690,811.99	$586,403.35	$104,408.64 Inc.
Net...........	365,868.16	323,140.48	42,727.68 "

Edison Electric Illuminating Earnings including Manhattan and Harlem Companies.

	May	Five Months.
Gross........................	$144,307.91	$811,565.16
Net...........................	72,092.88	405,026.18

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

A NEW FACTORY FOR THE WESTON ELECTRICAL INSTRUMENT CO.

IT is reported by the Newark, N. J., papers that the Weston Electrical Instrument Company has found its quarters too contracted in the building at the corner of William and Shipman streets, and has arranged for an extensive plant at Waverly. The company has purchased about forty-eight acres of land for the purpose. This will be opened up in building plots for employés of the works, and the property will be rented or sold upon easy payments to the employés of the company. About 100 cottages will be built upon this tract by the company.

Edward Weston.

The factory plot is a diamond shaped tract containing twenty-four and one-half acres, and was sold to the Weston Electrical Instrument Company by the Mutual Benefit Insurance Company. With it the company purchased a pretty triangle of land which will probably be occupied by stores.

The factory buildings will be modern structures, with immense floor space, and not exceeding two stories in height. In addition Mr. Edward Weston will erect a model laboratory on the tract and will equip it with fine machinery, instruments of accuracy and a complete stock of valuable chemicals. Mr. Weston has other things in view besides the manufacture of his direct-reading voltmeters and ammeters, and will begin upon a new line of work as soon as the details of the present line of manufacture are completed and the new plant is in perfect operation. It will be a model establishment in every respect, and it is proposed to employ nearly one thousand persons at the Waverly shops. Every detail of the work will be systematized more thoroughly, perhaps, than in any other factory in this country, and it is expected that everything will go along as smoothly as fine clockwork.

The actual work of building can hardly be started until early in September, as the plans are not yet made. The buildings upon the factory tract will all be constructed of steel and brick, with a view to making them as nearly fireproof as possible. A spur will be run into the yard from the Pennsylvania Railroad when the plant is completed, and the company will thus have every facility for getting stock and fuel and for shipping its products. At the same time it will have the advantage of the proximity of the Lehigh Valley road and the trolley line.

PROPOSALS WANTED FOR THE NEW ALTOONA CENTRAL STATION.

PROPOSALS will be received by the Edison Electric Illuminating Company, of Altoona, Pa., up to 12 o'clock noon July 1, 1895, for the building of a new plant—steel stack and trestle. Also the furnishing of the following machinery, wire, etc., as follows: One station building, size 109 x 84 feet, steel frame and brick, complete with coal trestle, storage cistern and traveling crane. One steel plate stack, self-sustaining, 125 feet high, 8 feet diameter, brick lined one-half of height, and britching from boilers to stack. 1,000 H. P. boilers—units of 250 H. P. each—150 lbs. working pressure. Two 800 H. P. closed coil feed water heaters. Two duplex boiler feed pumps, maximum capacity 500 gallons each per minute. Three 200 H. P. compound automatic engines for belted dynamos. Two 225 H. P. compound automatic engines for General Electric direct connected generators. Above engines may be either tandem or cross compound type. Valves and cylinders so proportioned that maximum efficiency shall be obtained at 75 per cent. of full load. Initial pressure, 150 pounds. 320 cross arms of Georgia pine, 4" x 4½", 6 ft. long, 8 pins, 1½". 640 2-feet galvanized iron braces for same. 2,5.0 locust pins, 1½". 8,000 glass insulators, regular deep groove pattern. 320 cross arm bolts, 14" long, ½" and ⅝". 640 cross arm bolts, for braces, 4½" x ½". 320 lag screws, 4" long, for braces, Fetter pattern. 600 pole steps, Fetter pattern. 1,500 feet ⅜" stranded guy cables, galvanized iron. 20 pcs. stranded guy cable clips or fastenings. 58,000 lbs. 000 and 0000 bare copper wire. 3,450 lbs. No. 4 weather-proof copper wire. 2,800 lbs. No. 6 weather-proof copper wire. 30 poles 40 feet long, 8" diameter at top. 5 poles 45 feet long, 8" diameter at top. 5 poles 50 feet long, 7" diameter at top.

Bids will be received on any of above articles separately or on all of them together. The Company reserve the right to reject any or all bids. Specifications and drawings can be had upon application to A. J. Anderson, Secretary, Edison Electric Ill. Co., Altoona, Pa.

RECENT ORDERS FOR GOULDS PUMPS.

The Goulds Mfg. Co., Seneca Falls, N. Y., reports recent sales of their triplex power pumps to the following: Freydenburg Falls Paper Co., Plattsburgh, N. Y., one 12" x 12" pressure pump to be used with grinders. Jay Paper Co., Jay, Me., one 7" x 8" stuff pump to be used for pumping stuff. Lewiston Foundry & Machine Co., Lewiston, Pa., two 1¼" x 2" triplex power pumps for boiler feeding. Tide Water Oil Co., Bayonne, N. J., three 4" x 6" triplex power pumps, two of these to be used for pumping oil and one for pumping water, one 1⅞" x 6" and one 2⅛" x 6" which are to be used for pumping ammonia. Standard Oil Co., of New York, Olean, N. Y., Refinery, two 8" x 12" triplex power pumps for water supply. P. H. Potter, Springfield, Mass., one 4" x 6" triplex power pump for boiler feeding. Worcester Engineering Co., Worcester, Mass., one 12" x 12" triplex power pump for water works system at Millbury, Mass.

SUPPLY MFG. CO., OF PITTSBURGH.

Owing to the large increase in their business, the Supply Manufacturing Co., of Pittsburgh, have found it necessary to remove to larger quarters. They have purchased a large building at 32nd and Smallman Sts., Pittsburgh, and have transferred all their machinery and stock to it. They have now a splendidly equipped factory with every convenience for turning out promptly and accurately any electrical work. Their specialities are the Pittsburgh Tablet Board, the Pittsburgh Insulating Joint, commutators new and refilled for every system, armature and field winding, mast arms, trolleys and street railway renewals of every description.

THE WILKESBARRRE STATION TO USE CULM.

Mr. J. H. Vail of No. 39 Cortland street has been engaged by the Wilkesbarre Electric Light Co., as Supervising and Contracting Engineer for the building of a large electric lighting and power station. The Company have purchased a valuable culm bank in Wilkesbarre, containing upwards of 140,000 tons of excellent coal and propose erecting a modern power house and new steam plant on the property. When the new station is completed the Company will be in a position to manufacture current at as low a price as it can be produced in this country, excepting from cheap water power. The work is expected to be completed in from three to four months.

WILLIAMES' VACUUM SYSTEM OF STEAM HEATING.

Warren Webster & Co., of Camden, N. J., have just issued a very interesting and useful little pamphlet in the shape of a treatise upon the vacuum system. The text illustrates and describes the Williames plan by means of which an attachment is furnished whereby a partial vacuum is maintained in the piping, thus insuring perfect circulation through the heating coils; with minimum of condensation, leakage and waste of fuel. The system has been tried and approved by hundreds of users, whose testimonials are reproduced in facsimile. It has been laboriously imitated by infringers whose fate is here set forth in hard, stern legal injunctions. The points of merit and economy in favor of the system are well made, and the pamphlet as a whole is an excellent piece of technical literature advocating a standard speciality.

SULZER-VOGT MACHINE COMPANY.

The Sulzer-Vogt Machine Company, of Louisville, Ky., have published a catalogue in which the advantages of the electric elevator, and especially the particular form of Elektron elevator of which they have made a specialty, are clearly set forth. In comparing the electric with the hydraulic elevator, they show that the former does not involve the maximum cost for lifting the minimum loads; does not creep away from the landing if left for a few minutes; has no water pipes to fill up or corrode; no excessive weight to bring the car down; no air to cause runaways; no leaking valves or cylinders; no piston to pack and grease; no frozen or burst pipes; no flooded cellars, and no heavy or unsightly tanks on roof or pressure tanks occupying valuable space. On the contrary, it is easy to start, runs and stops smoothly, requires little attention, is safe, simple and inexpensive to operate, and last but not least, effects a considerable economy in space.

MORE ELECTRIC ELEVATED FOR CHICAGO.

The management of the Lake Street elevated road in Chicago has decided to discard steam and adopt electricity.

PHOENIX CARBON CO.

The annual meeting of the Phoenix Carbon Mfg. Co. of St. Louis, Mo., was held on June 11, when the following directors were elected: S. M. Dodd, S. B. Pike, T. H. West, J. C. Van Blarcom and James Campbell. The new board met after the election and chose as officers: S. M. Dodd, president; S. B. Pike, vice president; H. L. Page, secretary and treasurer, and S. G. Booker, superintendent.

THE ELECTRIC PORCELAIN & MFG. CO.

Trenton, N. J., is well-known as a centre of fine pottery manufacture, and it is not surprising therefore to find established there the Electric Porcelain & Mfg. Co., at 309-315 Monmouth street. This concern makes high grade vitrified porcelain, and not only turns out standard pieces but makes a specialty of new and difficult designs. It will be glad to be favored with correspondence from any parties needing porcelain. F. F. Waecher is president of the Company; D. Crossley, vice-president; C. F. Adams, secretary and treasurer, and F. Louis Waecher, assistant secretary and treasurer.

ELECTRICAL WORK AT JAMESTOWN, N. D.

John A. Masters, of Chicago, has purchased the controlling stock interest of the Jamestown Electric Light Company and has been elected its president and general manager. Mr. Masters has had years of practical experience in the management of electric plants and for the past year has been taking a special course in the Electrical Engineering Department of the Armour Institute, Chicago. The company expects to improve its plant and is in the market for a small engine to take the light load after midnight.

Proposals for a 30 to 35 H. P. engine will be welcomed; also for a 100 H. P. feed water heater—and friction cut off couplings, hangers, etc.

ELECTRIC CALLS FOR THE HOUSE OF REPRESENTATIVES.

Mr. E. Clarke, architect of the Capitol, has ordered an electric call system for use in the House of Representatives, by means of which pages will be summoned as required, from an anteroom, with which each desk will be connected. About $1,000 will be spent on the work.

CHAINING THE WATERS OF THE ARKANSAS AND OF THE LAKE CREEK IN COLORADO.

Plans are understood to be maturing to use the water power of the mountain streams about Leadville, with a view to its conversion into electricity, and the sale of the energy to the various mines instead of steam. The high price of coal in that district would enable any concern which converted the power to charge a good price for it, and it would be readily taken up by the mines. Senator Poole, Colonel Roswell E. Goodell and other Denver capitalists, are backing the scheme, which includes the construction of a large reservoir 1½ miles long and 1 mile wide, and the erection of machinery for the conversion of the power, at a cost of $250,000.

NEW YORK NOTES.

THE EDISON STATION at Elm and Duane streets was visited last week by Mgr. Satolli, Papal Delegate to the United States.

MR. D. E. WALKINS is preparing plans for the first section, 22 miles of electric railway, for the Minneapolis, St. Paul and Ashland Railway. Chas. H. Pratt, Minneapolis, Minn., secretary, may be addressed.

THE ELECTRIC APPLIANCE CO. of Chicago was most pleasantly represented in New York last week by Mr. Low, who reported business with his company to be brightening up in a most remarkable manner. They were never busier. It is a pity Mr. Low cannot get around to New York oftener than once in two years.

W. R. OSTRANDER & CO., of 204 Fulton Street, have issued the tenth edition of their revised catalogue, which now makes a portly volume of nearly 200 pages. It includes and illustrates the leading specialties and standard goods in speaking tube hardware, electric bell goods, electric light material, telegraphic and telephonic apparatus and general electrical supplies.

MR. J. H. VAIL, 39 Cortlandt Street, is prepared to act as consulting and supervising engineer for the design and construction of electric railways, electric transmission of power, electric light stations, and systems of distribution; as well as general engineering work. Mr. Vail is so well known that no introduction or comment is necessary.

MR. H. H. HARRISON has taken an interest in the business of Mr. R. B. Corey, and is to be found henceforth at the Corey headquarters in the Havemeyer Building this city, where he will assist in the business of arc lamps and carbons carried on there. Mr. Harrison is well known to the trade and among engineers, both West and East, and in railway as well as lighting work.

MR. G. W. DAVENPORT, of the United Electric Securities Co. of Boston, was a welcome visitor to New York last week and a caller at the office of THE ELECTRICAL ENGINEER. Mr. Davenport is an expert in electrical investments, and speaks most hopefully of the increase in the earnings shown by all electrical properties that are under careful and progressive management.

SUPERINTENDENT E. G. RUSSELL, of the Rome, Watertown and Ogdensburg Railroad Company, has been tendered the presidency and general management of the Brooklyn Heights Street Railway and the Long Island Traction Company at a salary of $12,000 a year. It is very probable that Mr. Russell will resign his position with the R. W. & O. Company to accept the place.

THE FIBERITE CO. of Mechanicville, N. Y., are having a large demand for their many electric specialties, especially in the line of switches, and have so many enquiries for these goods that they have a good opening at present for a young man to take hold of this branch of their business. They are also on the lookout for a good house to represent them in New England.

WESTERN NOTES.

ELWOOD, IND.—A factory site has been located for the manufacture of telephones for the Pana Company, which will make Elwood its headquarters.

THE AMERICAN CARBON CO., Dayton, O., notifies the electrical public that it has removed its factory to Noblesville, Ind., where it should now be addressed.

TOMAHAWK, WIS.—The Standard Telephone Company has just completed a telephone system in this city. The company uses the French Milde system.

MINNEAPOLIS, MINN.—The Court House and City Hall commission have awarded the contract for electrical machinery to the D. & D. Manufacturing Company at their bid of $16,388. The bid includes three generators, storage battery, switchboards and connections.

PERRY-FAULKNER.—Cards are out for the wedding on June 27 of Miss Lucretia Faulkner, daughter of Mr. and Mrs. Samuel Faulkner, of Chicago, to Mr. Frank Loney Perry, associate editor of the *Western Electrician*. The announcement is of interest to many friends of Mr. Perry, not only in the West, but in the East where for some time he represented the progressive and successful periodical with which he has so long been connected. If the marrying off of its staff be any criterion of a journal's success, the *Western Electrician* must indeed be doing well.

NEW ENGLAND NOTES.

THE BAY STATE PNEUMATIC DELIVERY CO. has been organized under the laws of Maine to make and sell pneumatic tubes and electrical devices of all kinds. The capital stock is $500,000. The officers are: G. M. Woodward, of Taunton, Mass., president; and G. C. Morrill, of Boston, treasurer.

THE WEST END RAILWAY, of Boston, has recently placed an order with the General Electric Company, covering two 800 kilowatt, two 1,300 kilowatt and one 1,500 kilowatt generators, all to be directly connected to the engines. This is one of the largest orders for railway generators ever placed at one time.

SOUTHERN NOTES.

PALM BEACH, FLA.—Mr. A. T. Best has secured the contract for the entire installation of the electric lighting plant in the Royal Poinciana Hotel, Palm Beach. It will furnish current for 5,000 lights. Mr. Best is to begin work at once and is making the hotel his headquarters.

PHILADELPHIA NOTES.

THE ELECTRIC STORAGE BATTERY CO. has closed a contract for batteries for the city of Minneapolis, to be used in connection with the Sprague elevators in the new public buildings in that city.

MOYES BOILER LITIGATION.—Mr. L. M. Moyes, the patentee and manufacturer of the Combine Safety Water Tube Boiler informs us that, through his attorneys, Messrs. Biddle & Ward, of Philadelphia, he has entered suit against the Stirling Boiler Co., of Barberton, O.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XIX. JUNE 26, 1895. No. 373.

THE MUNICIPAL WATERWORKS AND ELECTRIC LIGHT PLANT OF NORTH ATTLEBORO, MASS.

THE question of combining electric light plants with municipal waterworks in minor cities has assumed considerable importance, and there is every indication that the number of such plants is to be largely increased during the next few years. The last issue of THE ELECTRICAL ENGINEER contained a good deal of data bearing upon this interesting subject, and we are now able to supplement that with a description of the combination plant at North Attleboro, Mass., which is receiving marked attention in New England, as a typical station. This is not merely a plant established to furnish street lights, but is regarded as a source of revenue, and, so to speak, is run for a profit. Another noteworthy feature is that it not only combines water with electricity, but uses incandescent lighting instead of arc for the streets.

It having been decided that it was an altogether wise and proper thing to expend public money in such an enterprise, it was next decided by the town to annex the plant to the existing waterworks; and the committee appointed also secured the services of Mr. C. O. Mailloux as electrical engineer for the work. Fig. 1 illustrates the combination building, the original part of which was the pumping station located in the small portion with the smoke stack at the right of the engraving. To that was annexed the central structure for the power plant, and the square tower for offices and as a wire cupola. The electric light plant, by itself, occupies a space 68 feet by 54.

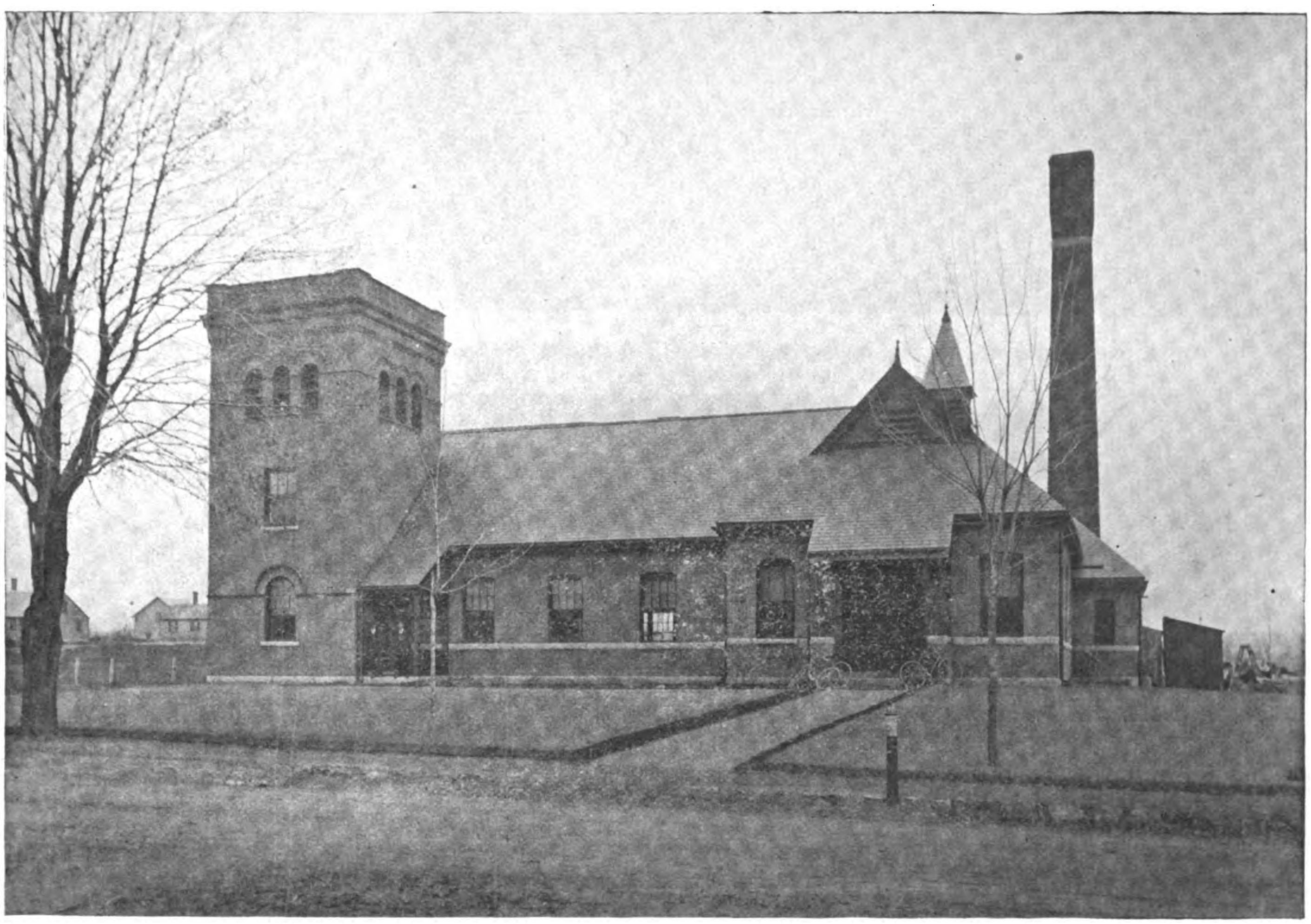


FIG. 1.—MUNICIPAL ELECTRIC LIGHT AND PUMPING STATION, NORTH ATTLEBORO, MASS.

The steam plant Figs. 2 and 3, comprises two engines both installed by the Fitchburg Steam Engine Co. One is a 13 by 24 by 32 tandem compound condensing engine of 175 H.P. nominal, running at 110 revs. per minute, and belted backward, over an idler pulley to the countershaft. The other is a 12 by 13 high speed engine of about 100 H. P. capacity, set in line with the countershaft and so ar-

ranged as to be directly coupled thereto by a clutch, when desired. These engines are furnished with steam by a Climax (Morrin) boiler of 250 H. P. furnished by the Clonbrook Co. of Brooklyn, N. Y., guaranteed capable of evaporating 7500 pounds of water per hour with 750 pounds of coal. The dynamos were furnished by the General Electric Co. and are of the Thomson-Houston pattern, alternating, one of 60 K. W., equal to 1000 lights of 16 C. P. and one of 120 K. W. equal to 2000 lights. By means of two friction clutches the load can be instantly shifted, in the usual way on or off either engine; so that in starting up for the commercial lights at 4.30 or 5 P. M. the small engine suffices; and at dark, when the street lights come on the large engine will take care of the entire load; besides which, the plant may be said to be, in a sense, duplicate, and protected against entire breakdowns. Even the boiler plant is reinforced by the horizontal tubular boilers used for the pumping plant. A Deane condenser is used in connection with the larger engine.

Fig. 4 shows the switchboard which is well built, comprising 11 bank boards for as many circuits each carrying 50 odd lamps of 32 C. P. each, and so grouped that any one of these different circuits can be cut in and out at pleasure. There is a spare bank for additions to the plant. A most striking, and commendable part of the work is that the circuits are protected from lightning at three points: namely, in the middle of each circuit; where the wires enter the station; and at the switchboard.

The line construction was done by the Hawks Electric Co., of Boston, with neatly painted round poles. The total cost of the plant was $49,081. The report for the first year of operation shows receipts of $7,475 from street lighting and $2,300 from commercial, a total of $9,775. Against this, for expenses, is charged interest at $50,000 of bonds at 4 per cent., $2,000; and $6,500 for all outlay for maintenance, depreciation, repairs, &c.; leaving a balance of $1,775 on the year's operations. The building committee, T. I. Smith, chairman; E. I. Franklin, and G. K. Webster, secretary, say in their report: "This income will largely increase each year as more commercial lights are sold; and we would add here for the benefit of those taxpayers who own property outside of the direct benefit of the service that there is good reason to believe that inside of three years the sale of commercial lights alone will pay for all maintenance, interest on the bonds, and leave a margin of profit besides; so that instead of a tax to support it, you will derive an income from it, all paid by individual users." Mr. C. O. Mailloux, the electrical engineer, in a supplementary report, speaks of the equipment as representing "more value quantitatively and qualitatively

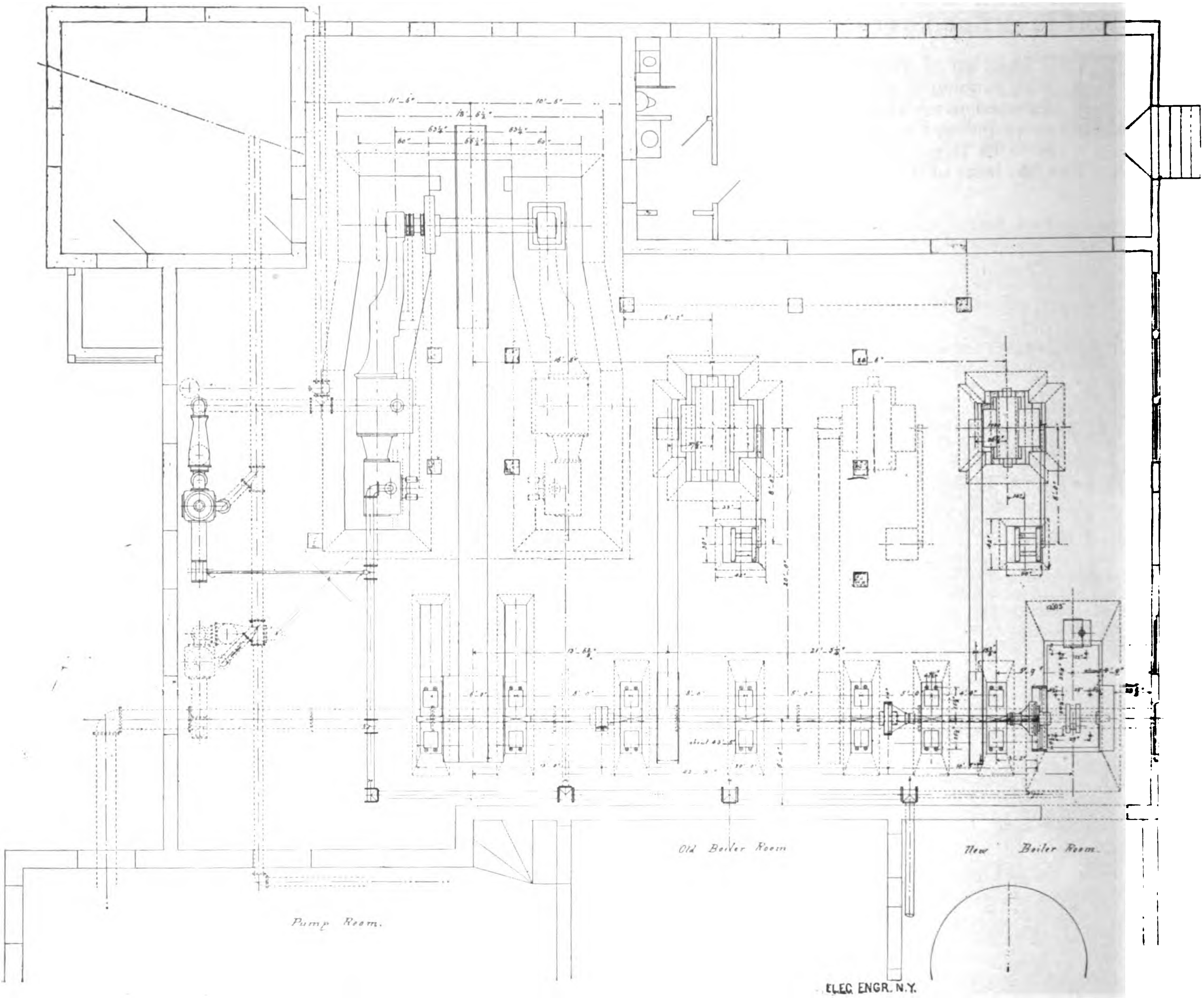


Fig. 2.—Plan of Steam and Dynamo Plant, North Attleboro, Mass.

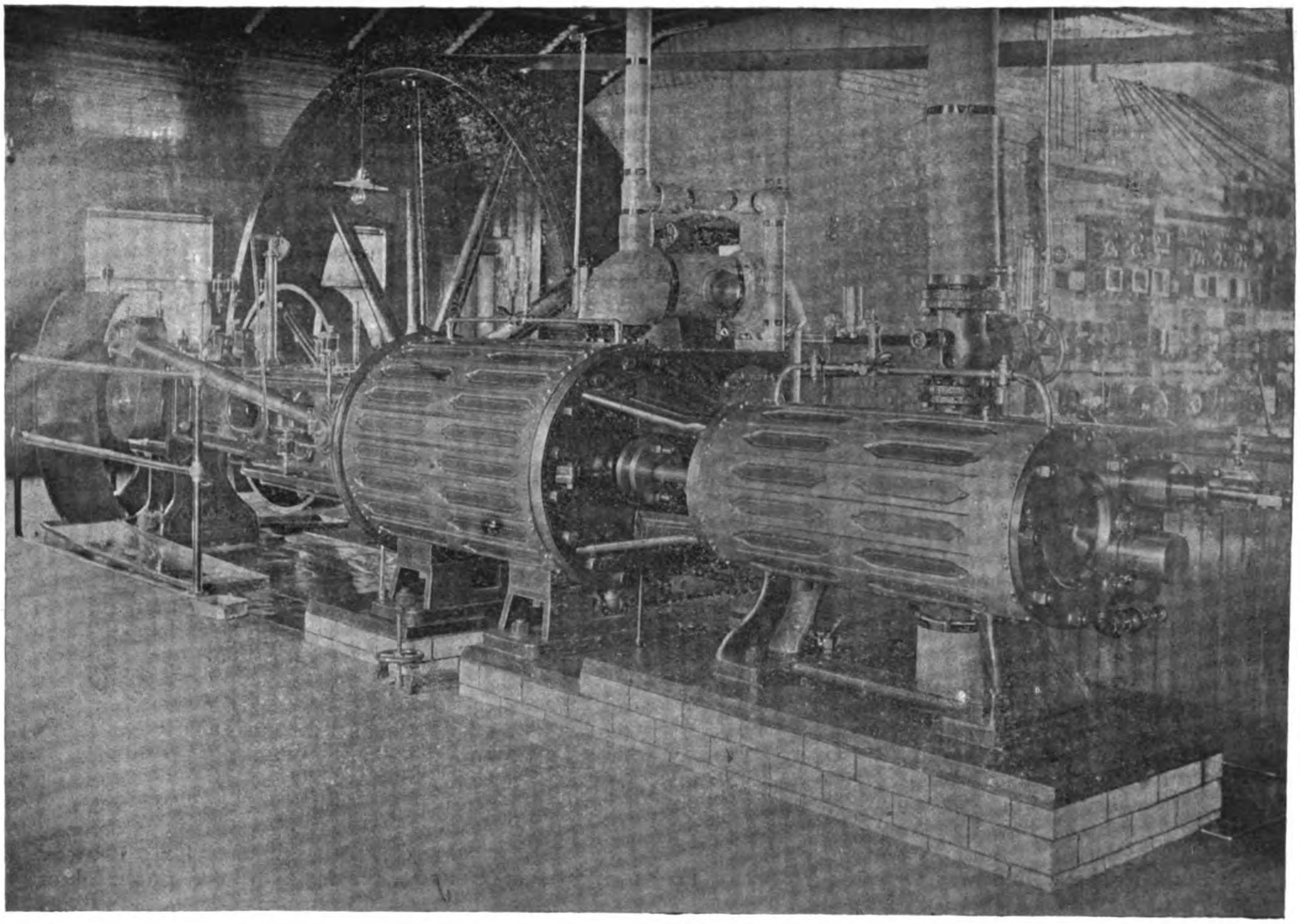


FIG. 3.—175 HORSE POWER TANDEM COMPOUND ENGINE FOR STREET LIGHTING SERVICE, NORTH ATTLEBORO. MASS.

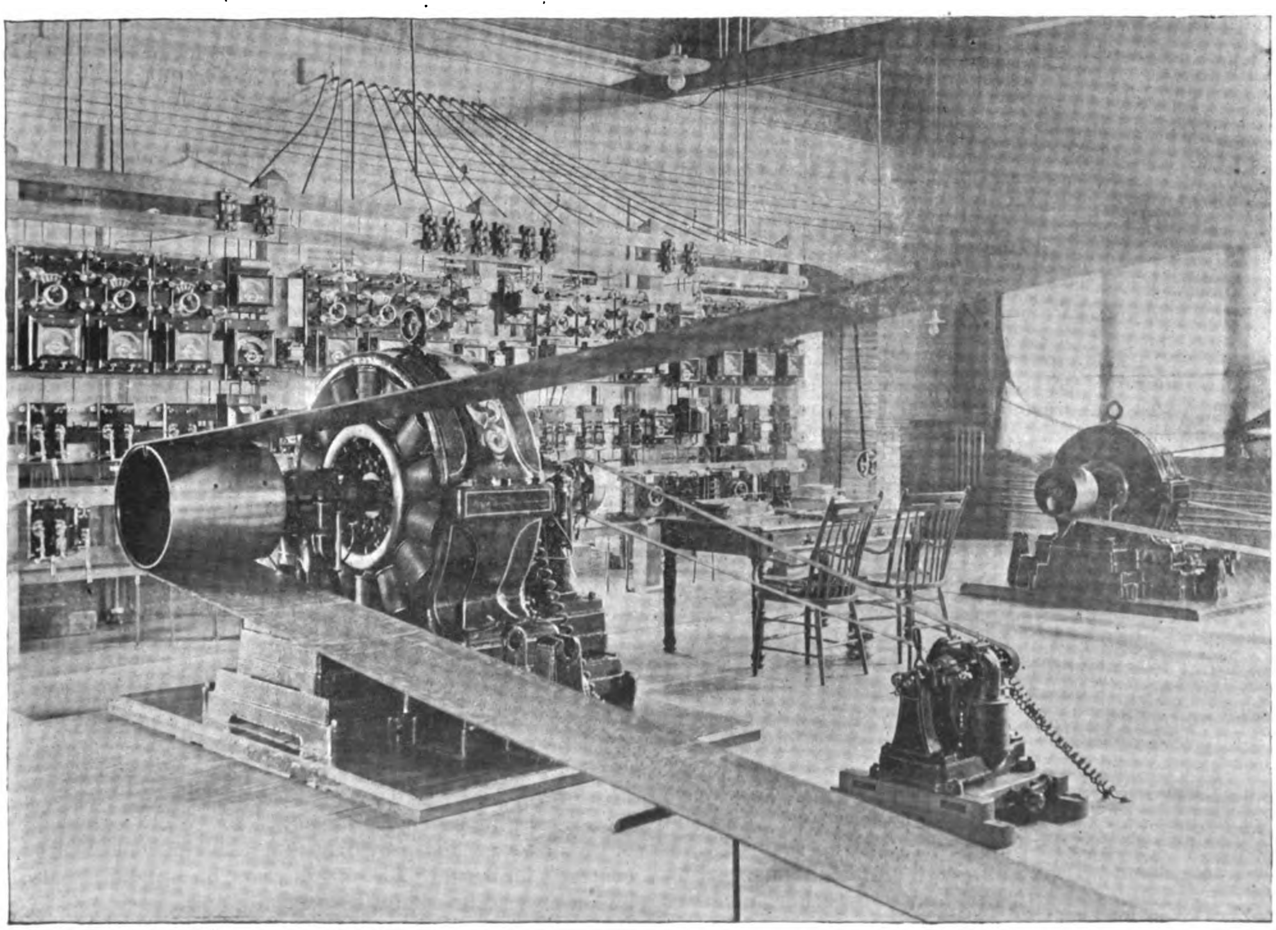


FIG. 4.—3,000 AND 1,000 LIGHT DYNAMOS WITH SWITCHBOARD CONNECTIONS, NORTH ATTLEBORO, MASS.

for the amount invested than any plant of its size and capacity"; and he expresses the belief that it ought to make a better showing in cost of production than any other station of its class. We hope at some time in the near future to analyze the statistics of this plant, which is now regarded as an exemplar in New England, and is the scene of many pilgrimages made by enthusiastic municipalites.

THE SHUNT vs. THE DIFFERENTIAL ARC LAMP.—I.

BY

E. R. Knowles, C. E.

THE evolution of the electric arc lamp from the first primitive form to its latest and most perfected type, forms an interesting study. In its earliest and simplest form it was only intended for use in demonstrating certain peculiarities and properties of the electric current.

As used by Sir Humphrey Davy in 1808, when first shown in the laboratory of the Royal Institution, in London, it consisted of two sticks of carbon fixed to metallic rods insulated from one another. These rods were arranged end to end on the same axial line. One of them was fixed and one was movable by hand, and could be made to approach to or recede from the fixed carbon. The movable carbon was first brought into contact with the fixed carbon and then drawn away a little to start the electric arc and then as the carbons were consumed it was, from time to time, pushed nearer the fixed carbon so as to maintain the length and resistance of the arc practically constant, and so also its steadiness and brightness. All this was done by hand and was very crude and of no value except from a purely scientific standpoint.

The next improvement made was to so arrange the apparatus that the carbons would adjust their relative positions automatically, and so dispense with the uncertain and tedious hand regulation. Perhaps the earliest and one of the best regulators of this type was the well known Foucault regulator afterwards simplified and perfected by Duboscq. In this type of lamp after the arc was started by hand, its length and resistance was maintained practically constant, and the movable carbon caused to approach the fixed one by means of suitable gearing controlled and operated by an electro-magnet placed in the *main* circuit, and through which the *total* current which caused the electric arc passed. As the carbons burned away and the arc lengthened, its resistance increased and the current flowing in the circuit diminished, and the electro-magnet weakened, allowing the gearing to act and one carbon to approach the other until the current and electro-magnet regain their normal strength and caused the gearing to cease acting and so stop the further movement of the carbon. A great many modified forms of this type of lamp were afterwards introduced, all of them, however, involving the same principle, that of using an electro-magnet located in the *main* circuit through which the *total* current passed and whose variations in strength due to the variations of the current strength served to automatically regulate and maintain practically constant the length and resistance of the electric arc.

This type of lamp could only be burned singly upon a circuit. If it was attempted to burn two or more of them in series on the same circuit it was found that they would not work together. One would burn brightly and the other dimly or not at all, the whole action being very irregular and fluctating. As the arc of one or the other lamp lengthened, its resistance increased, the total circuit resistance was increased and the current flowing in the circuit diminished. All the electro-magnets in circuit were weakened and all the lamps fed simultaneously, thus bringing the carbons of all the lamps together whether their arcs were too long or not. The result of this was that some of the arcs would be normal, others too long or short and some would be closed entirely. No possible arrangement for automatically keeping the current flowing in the circuit at a constant amount would have corrected this difficulty as the action of the lamp depended on the *variations* of the current flowing through the lamps.

To overcome this difficulty a lamp was introduced which, while still operated by an electro-magnet, had this magnet placed in a circuit which was connected around the arc to the terminals of the lamp or in a derived or *shunt* circuit to the main circuit in which the carbons were placed. By this arrangement two paths were open to the current, one through the main circuit, the carbons and the electric arc, and one through the shunt-magnet. When the length of the arc increased, its resistance also increased and the amount of current flowing through it diminished; at the same time the current flowing through the shunt magnet was increased and with it the strength of the shunt magnet. This shunt magnet controlled similar mechanism to that in the lamp already described and by similar means controlled the automatic action of the lamp; but with this difference, that the regulation of the lamp was effected by means independent of the total current flowing through the arc; and by properly proportioning the resistance of the shunt magnet, the total resistance of the lamp and so the current flowing through the lamp was maintained at all times nearly constant. In this way a number of lamps could be operated in series upon the same circuit, as the action of each was in a measure independent of the others.

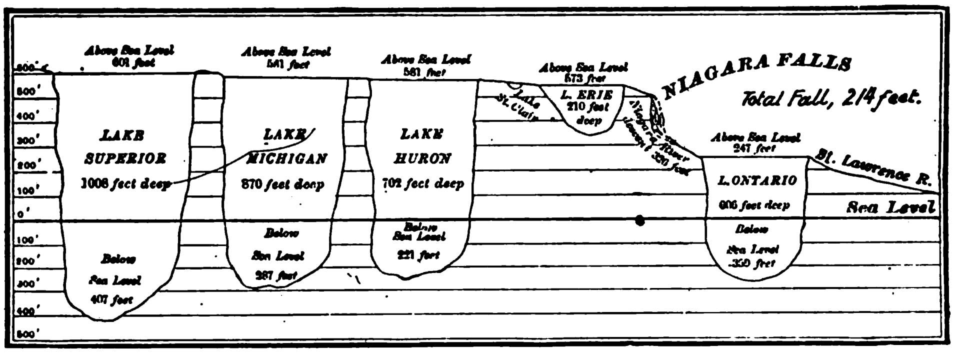
This type of lamp was first made in 1855 by Lacassagne and Thiers and was called the "shunt" lamp and was the prototype of many of the lamps of the present day. It was found however that this type of lamp did not do all that was expected of it, as it was not possible to so proportion its shunt that the total resistance of the lamp would be constant within such narrow limits as was necessary for close regulation and steady running. The lamp was still further improved by Lacassagne and Thiers, who, in addition to the derived or shunt circuit magnet, added again the magnet in the main circuit, and so arranged the connections that one acted in opposition to the other. This permitted of a very close adjustment being made in the regulating mechanism of the lamp, making it very sensitive and rapid in its action, so that it maintained the total resistance of the lamp practically constant, and so necessarily the total current flowing through the lamp was constant.

This type of lamp was called the "differential" lamp, because it depended for its operation upon the difference in the action of a pair of electro-magnets, one located in the main circuit of the lamp and the other in a shunt or derived circuit around the lamp, the action of these magnets being opposed to one another, one strengthening as the other weakened, and vice versa.

I have thus roughly sketched three types of lamps, one operated by a main circuit magnet only and only capable of running as a single lamp; one operating by a shunt magnet only and running singly or under proper circuit conditions capable of running in series with other lamps of the same type; and one acting by means of the differential action of a main and shunt magnet and capable of running singly or under all conditions of circuit in series with others of the same type. I shall designate these lamps as the main, the shunt and the differential lamp.

FIFTEEN YEAR LIGHTING CONTRACTS.

Gov. Morton has signed the bill of Mr. Wray relating to cities of the first class and providing that municipal officers may make contracts for lighting for fifteen years, on a sliding scale basis, and at lower rates than is now fixed by law.

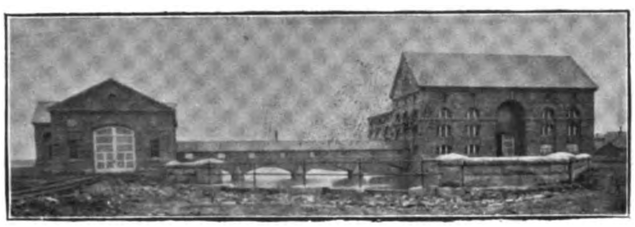


PROFILE SHOWING DIFFERENCE IN LAKE LEVELS OF THE GREAT LAKES.

THE WORK THAT HAS BEEN DONE AT NIAGARA.

I.

No one contemplating the scene of the falling waters at Niagara can fail to be inspired with the sense of power there concentrated, and even the savage, ignorant of all applications of motive power, as he gazed upon the scene before the white man set foot within it, must have been imbued with a sense of the great force in constant action before him. Civilized man, however, has always cast wist-

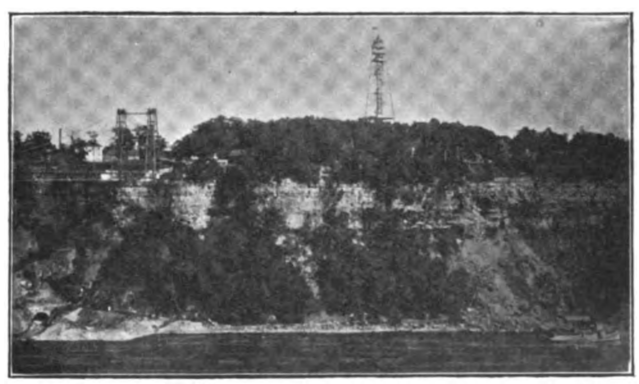


MAIN POWER HOUSE AND TRANSFORMER HOUSE.

ful glances at the available natural powers of the world and hence it is not strange that Niagara has long been the goal for which enterprising enthusiasts have been striving. For years past, indeed, the power of the Falls has been utilized to a very limited extent in a few mills and factories scattered for a short distance on the brow of the gorge below the Falls, but it was not until the great success achieved by the electric methods of power transmission had made its impression upon the world, that capitalists could be induced to venture on the utilization of Niagara's power to an extent commensurate with the force available. Alluring, and promising as the project now appears after five years of work have been expended upon it, the beginning of this great enterprise was in one sense as difficult a task as its practical carrying out; and the trials and disappointments of its projectors recall forcibly the remark of Lord Brassey that the work of building a tunnel from England to China would be less arduous than the raising of the capital with which to carry it out. The credit of the pioneer work on the new Niagara utilization scheme rests largely with Mr. William B. Rankine, secretary of the Cataract Construction Co., whose persistence finally gained the recognition of Mr. Francis Lynde Stetson, the well known lawyer, of New York, and who eventually succeeded in interesting in the cause a number of well known and enterprising capitalists at the head of whom stands Mr. Edward D. Adams, a gentleman whose ability as a conservative financier has been recognized on two continents.

II.

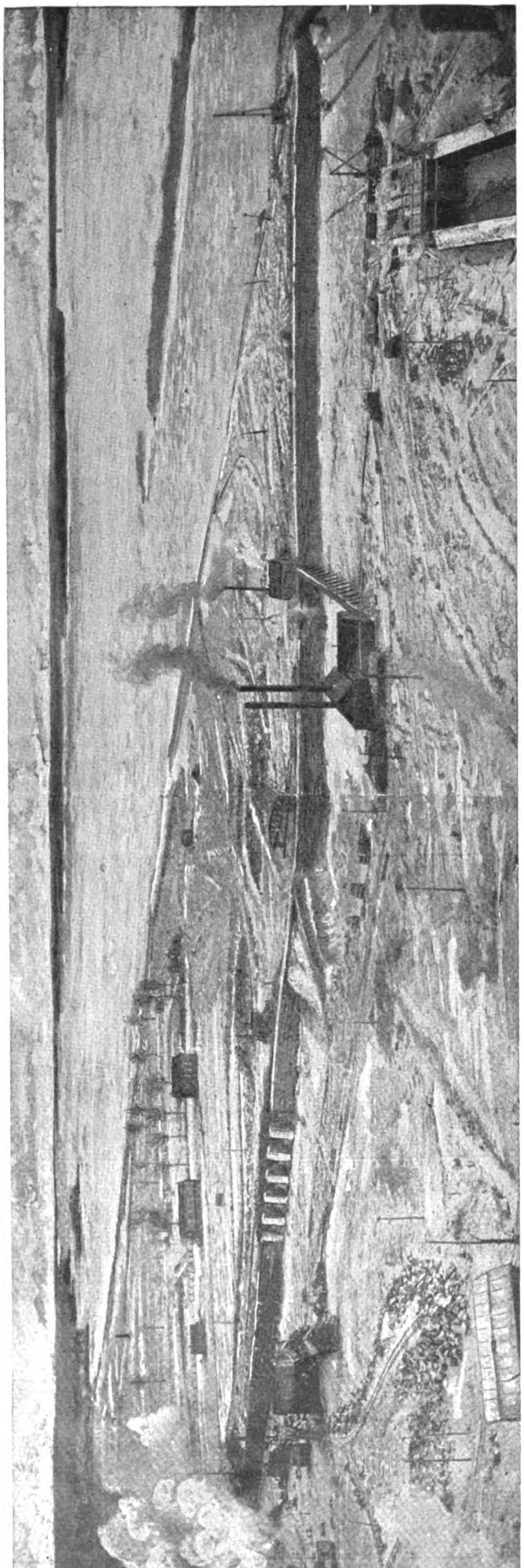
Before entering upon the actual work already accomplished at Niagara it may not be uninteresting to refer briefly to the origin of the great source of power which the Niagara Falls Power Co. has spent so many millions in developing, in order that some estimate may be formed of the solidity and stability of the enterprise. One of the objections to the utilization of most water powers is their inconstancy, due to lack of water supply at different seasons of the year,—an inconvenience, which has indeed resulted in a large reduction of the value of numerous waterpowers. That no such contingency need be apprehended at Niagara will become evident when we consider



NIAGARA GORGE, SHOWING PORTAL OF THE GREAT WATER POWER TUNNEL.

that the Falls constitute the spillway for a system of connected reservoirs consisting of Lakes Superior, Michigan, Huron and Erie, covering an area of over 90,000 square miles and draining a watershed area of nearly 250,000

VIEW OF ECHOTA, THE RESIDENCE SECTION, ADJOINING THE FACTORY SITES OF THE NIAGARA FALLS POWER CO.



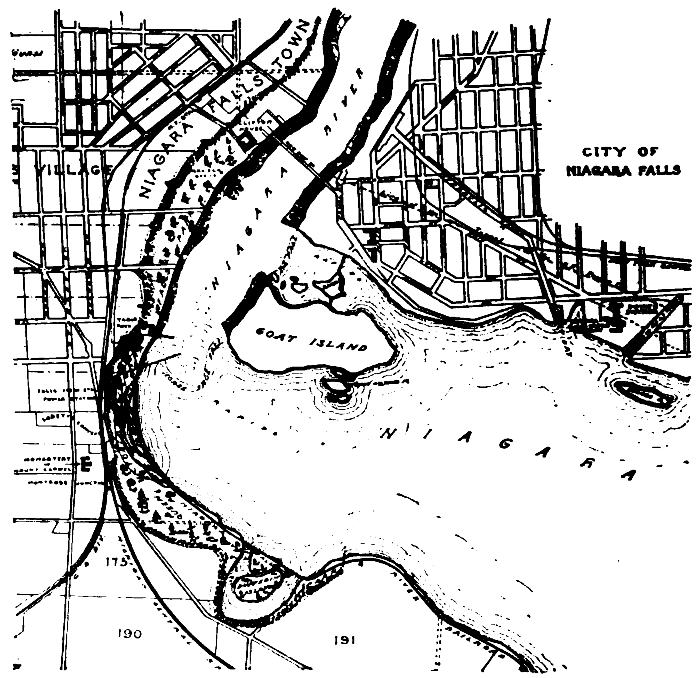
Bird's Eye View Showing Preliminary Work on The Power Canal.

square miles, extending half across the continent. The relation of the lakes to the Falls is well shown in the profile on page 583 which also gives the fall of level from lake to lake.

The volume of water which passes over the Falls has been variously estimated, the most reliable figure putting it at 265,000 cubic feet per second, corresponding to 7,000,000 H. P. actually available at the turbine shafts if the total height of the Fall from the Upper Rapids to the Whirlpool Rapids were redeemable.

But as the Power Co.'s tunnel provides for a fall of only 140 feet the power available if the entire Fall were utilized would be about one-half the above figure, or 3,500,000 H. P. As the plans of the company embody the initial diversion of water equivalent to only 100,000 H. P. on the American side, and 250,000 H. P. on the Canadian, the diminution of the level at the brink of the Falls will be barely perceptible. In fact, nobody but trained observers familiar with the scene could notice it.

The Niagara Falls Power Co. received its charter in 1886, but it was not until four years later that the actual



Map Showing Location of Power Houses on American and Canadian Sides.

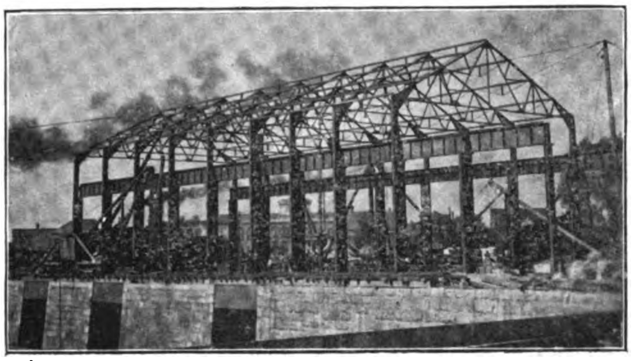
work of construction was begun. In the mean time the studying of the methods for carrying out the engineering problems involved had been entrusted to the International Niagara Commission, consisting of Lord Kelvin, Colonel Turettini, Prof. Unwin, Dr. Coleman Sellers, and Prof. Mascart, who invited the leading electrical and engineering specialists of the world to submit plans, and these were finally passed on by a board consisting of Dr. Coleman Sellers, Mr. Clemens Herschel, Major G. B. Burbank and Mr. John Bogart, with Prof. George Forbes as consulting electrical engineer.

III.

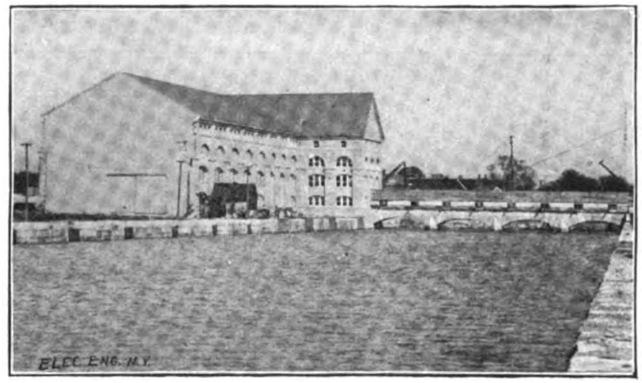
The plan finally adopted embraced the construction of a canal about 1½ miles above the American Fall, tapping the river, with a width of 300 feet and 1,500 feet long, and having a depth of 12 feet. Wheel pits sunk along the edge of this canal lead the water to turbines at the bottom, and the discharge is carried off through a great tunnel 19 feet wide by 21 feet high, 6,700 feet long, passing under the town of Niagara Falls and emptying into the chasm just below the Suspension Bridge, as shown in the view on page 583.

IV.

Electricity having been adopted as the system of distribution and the Tesla two-phase having been selected as that best adapted to fulfill the requirements which a diversified number of manufactures and utilizations might call for, the type and arrangement of generators and their connection to the turbines was given especial attention.



STEEL SKELETON OF POWER HOUSE.



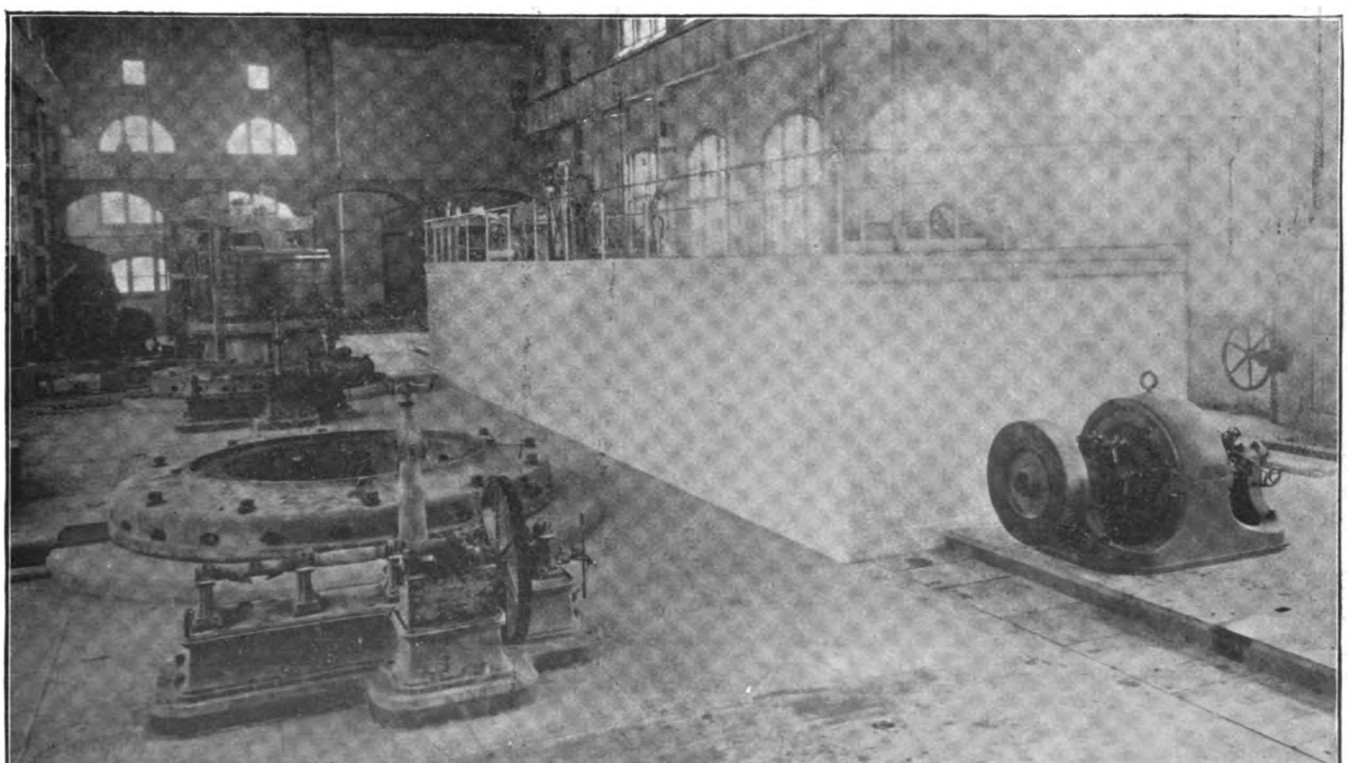
VIEW OF NIAGARA POWER HOUSE FROM CANAL.

After much deliberation it was decided to erect 5,000 H. P. units, and some of these have now been installed in the power house, views of which are given on pages 585 and 586. This station is designed for an ultimate capacity of 50,000 H. P., but for the immediate present only three units of 5,000 H. P. each will be set up.

The illustration on this page shows one of the Tesla two-phase generators now erected in the power house, and a good idea of its construction can be obtained from the sectional view on the page 586. To a circular foundation is bolted a vertical cast iron cylinder, provided with a flange on which the stationary armature rests. The inner part of the cylinder is bored to the shape of an inverted cone and serves as a bearing for another conical piece of cast iron, supporting the shaft-bearings. The armature core is made of thin, oxidized iron plates, held together by 8 nickel-steel bolts. In the outer edge of the plates are 187 rectangular holes to receive the armature winding.

The outer rotating field magnet consists of a wrought steel ring to which are bolted the 12, inwardly projecting, massive cast iron polepieces. The ring constituting the field magnet is supported by a six-armed cast-steel spider keyed to a vertical axis. The field-magnets act also as a flywheel. The shaft rests on two bearings supported by four arms projecting from the inner adjustable cast-iron cylinder. The bushings of the bearings are made of bronze provided with zig-zag grooves in which oil constantly circulates. On the outer side of the bushing there are also grooves into which cold water may be pumped, if required.

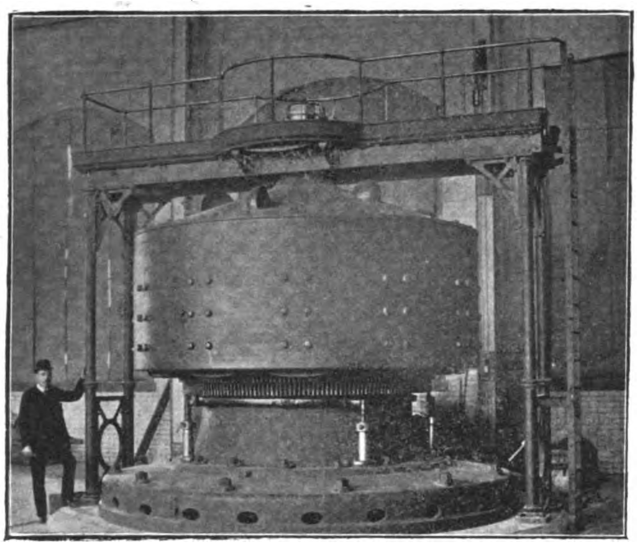
The armature conductors are rectangular copper bars, $1\frac{1}{4} \times 1\frac{5}{16}$ of an inch. Each of the 187 holes of the armature contains two of these bars, surrounded with mica. The upper and under sides of the armature are connected by means of V-shaped copper bars, riveted to the ends of the bars which project out behind the ends of the armature.



VIEW IN THE POWER HOUSE, SHOWING GENERATOR WITH ARMATURE EXPOSED, AND THE SWITCHBOARD GALLERY.

The connections are made so as to give two independent circuits. A pair of cables connects each circuit with the switchboard. The magnet-winding also is composed of bent copper bars, air-insulated, inclosed in brass boxes, two of which are fastened to each pole-piece. Continuous current for exciting the field magnets is obtained from a rotary transformer.

The current is conducted to the field coils by means of

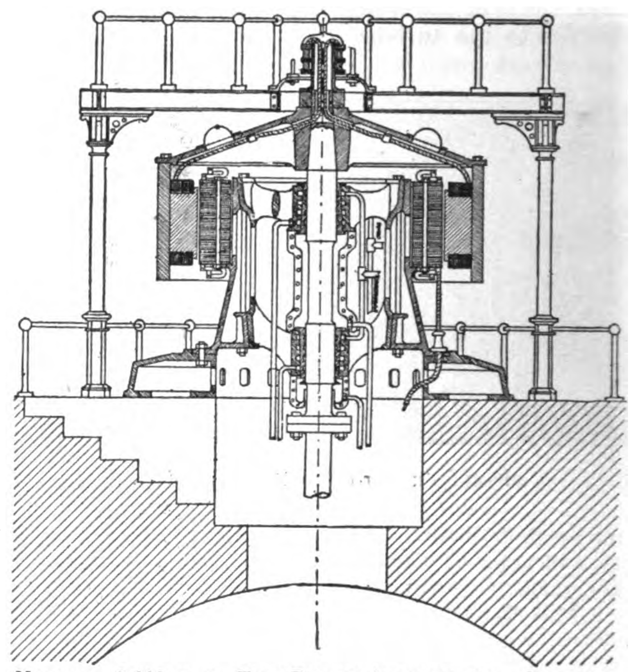


5,000 H. P. Two-Phase Generator in Power House.

a pair of brushes and two copper rings fixed to the top of the shaft of the generator. At a speed of 250 revolutions per minute the machine produces two alternating currents, differing in phase of 90 degs. from each other, each of 775 amperes and 2,250 volts pressure. The alternations are 50 per second. The height from base of bed plate to top of machine is nearly 13½ feet. All the generators were built by the Westinghouse Co.

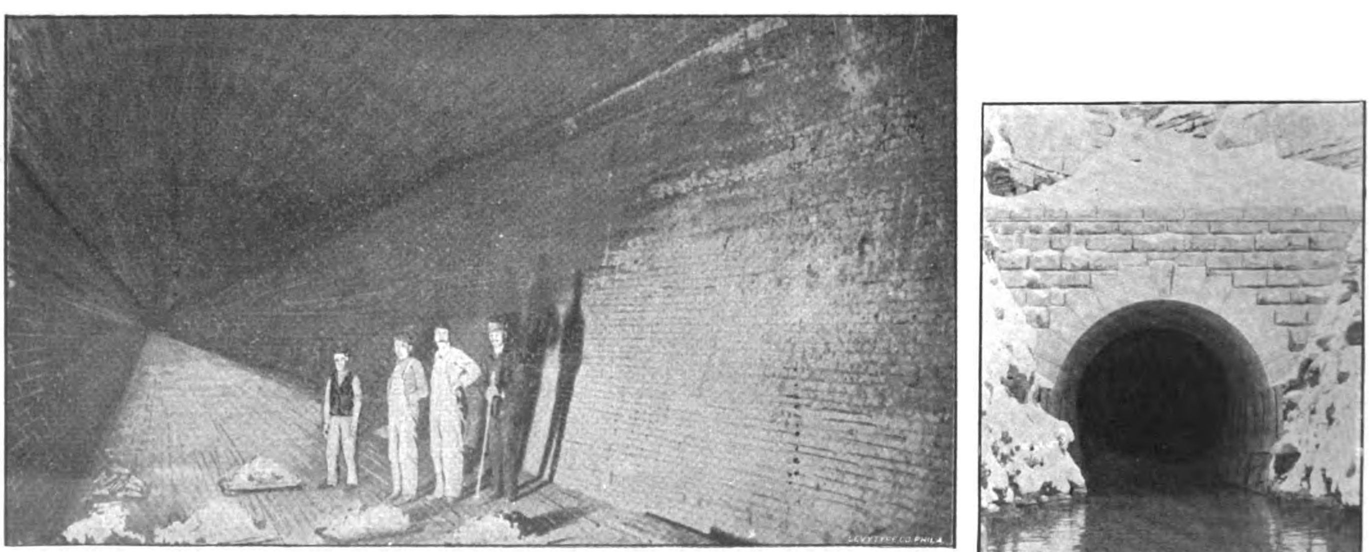
V.

The general plan of the connection of generator to turbines situated 150 feet below is shown on page 587 and the illustration on page 587 gives a section of the turbines, which were designed by Messrs. Faesch & Piccard, of Geneva, Switzerland, and built by the I. P. Morris Co., of Philadelphia. They are of the Fourneyron or Boyden type and special methods were adopted to relieve the bearings of the pressure of the superincumbent mass. The weight of the vertical shaft and the attached portions of the dynamo, amounting to about 152,000 pounds, is taken care of by



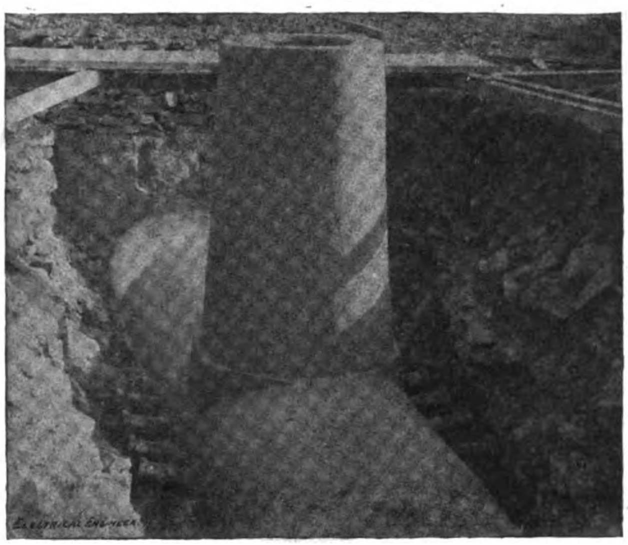
Niagara 5,000 H. P. Two-Phase Alternator.—Section.

closing the bottom of the casing so that the water cannot act downward upon any of the parts attached to the shaft, while in the upper end of the casing are apertures through which the water can act upon the under side of the disc carrying the movable blades of the upper turbine and relieve the bearings of the weight of the shaft. In this way the weight of the water column is sustained by the stationary portions, and the pressure due to the head made to act upward for supporting the weight of the revolving shaft, which is thus nearly in the condition of a shaft spinning upon the water. The area involved is so proportioned that when the wheels are lightly loaded the upward pressure will be some 2,000 pounds in excess of the weight of the shaft, and when the wheels are running at full gate about the same amount less than the weight of



View in The Great Tunnel and of its Portal Below The Falls.

the shaft, on account of the lesser pressure in the casing. This variation in pressure and direction is taken care of by a thrust bearing shown in section in the illustration. The

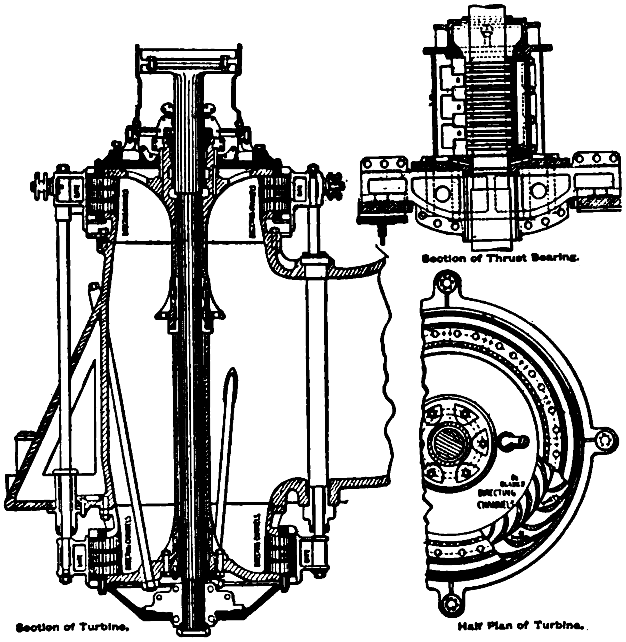


CONDUIT FOR ELECTRICAL CONDUCTORS SHOWING MANHOLE AND BRANCH OUTLETS.

shaft consists of a steel shell about a foot in diameter, with smaller solid portions for the journals.

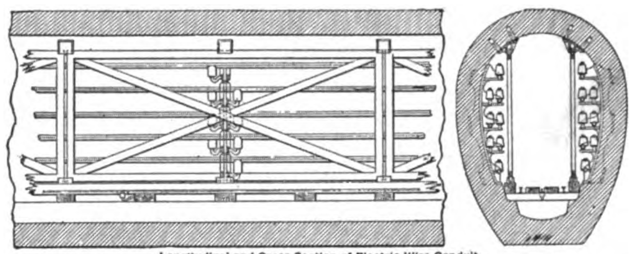
VI.

In carrying out its project of power utilization the Niagara Falls Power Co., has left the power user entire freedom in the selection of his methods. Thus he can dig his own wheelpits and put in his own turbines at $9 per H. P. per annum, or he can take the power from turbines furnished by the company at $12 to $15, or again he can obtain his power through motors fed by the current generated at the power house, at from $20 to $25 per H. P. per annum. For the latter purpose the lands of the company which include 7500 acres of factory sites and dwel-



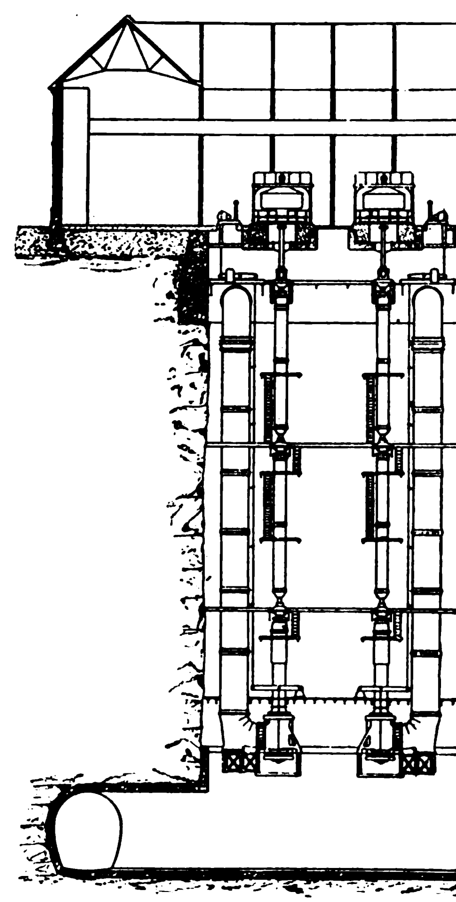
NIAGARA 5,000 H. P. TURBINES.—VERTICAL AND HORIZONTAL SECTIONS.

ling lots, have been provided with large conduits for carrying the electrical conductors, the general arrangement of which is shown on this page. The conduits are 5 feet 6 inches high by 3 feet 10 inches wide inside, and are built with 12 inches of Portland cement and gravel, and backed up by about one foot of masonary at the bottom and extending up the sides about 3 feet. The conductors are carried on insulated brackets on both sides. A track extends throughout the length of the conduit, upon which an electrically propelled car will carry the linemen between wire screens that protect them from the conductors and allow every portion of the line, brightly illuminated by the passing car, to be thoroughly inspected with absolute safety. The brackets are placed 30 feet apart. The engraving on this page shows one of the manholes which are placed at intervals of 400 feet. At the bottom will be seen the small outlets for tapping the conductors in the



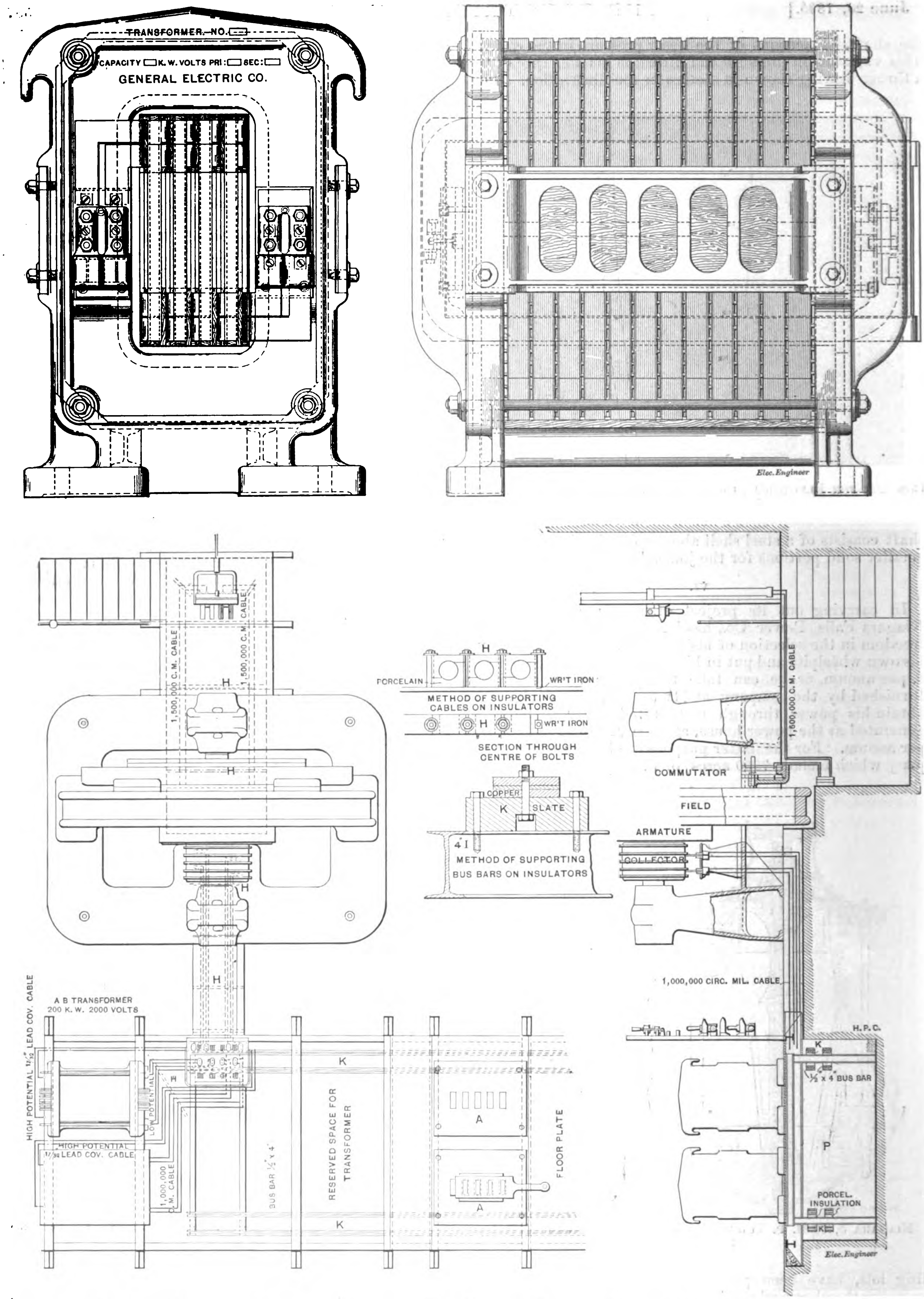
LONGITUDINAL AND CROSS SECTION OF ELECTRIC WIRE CONDUITS.

conduits. Besides this provision for the local distribution of power, the Niagara Falls Power Co. has wisely made provision for the calls which must inevitably follow for Niagara's



SECTION OF TURBINE SHAFT, SHOWING POWER HOUSE AND TUNNEL.

power from a distance. With the future in view, there has been constructed a transformer house directly opposite the main power house across the inlet canal and connected



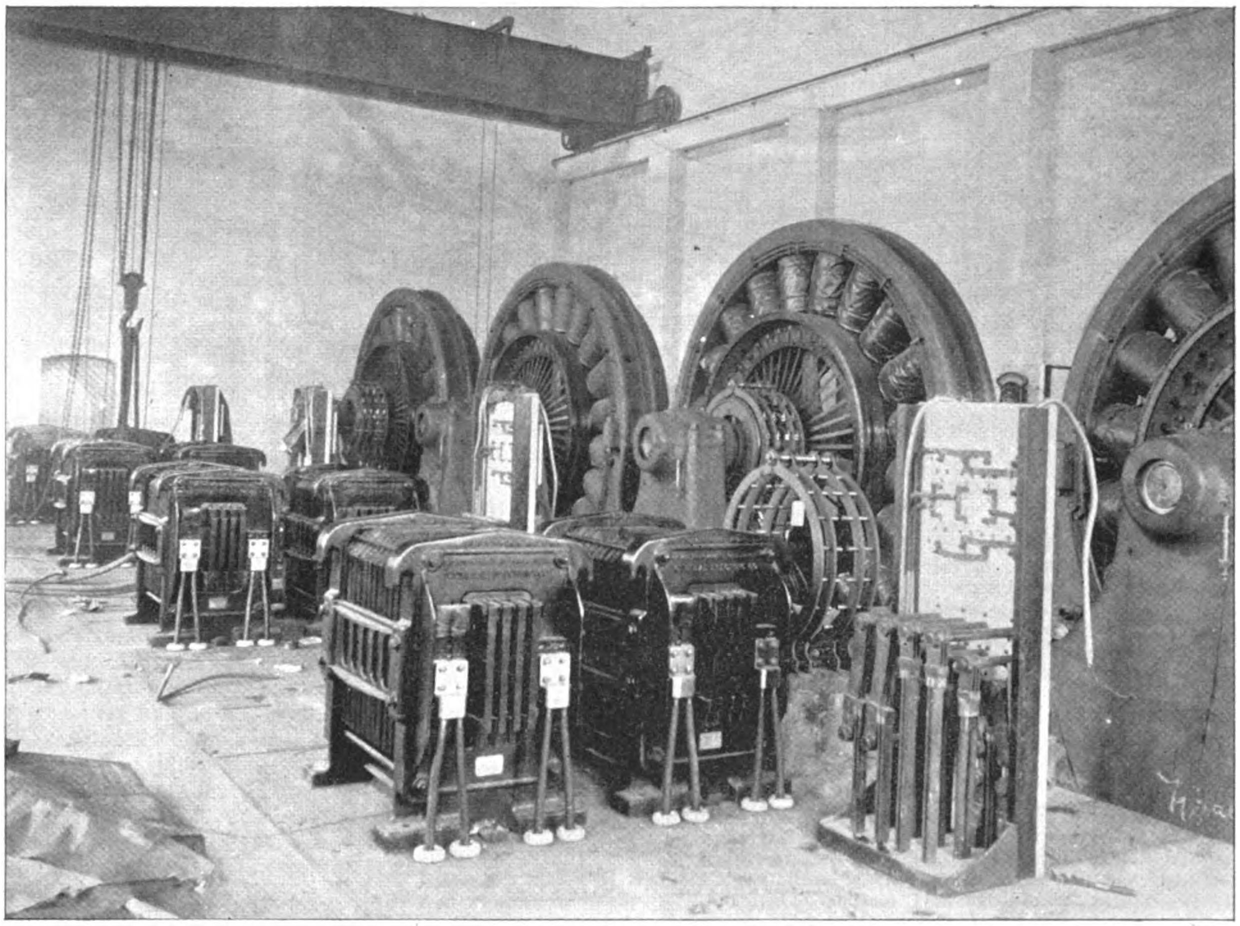
Plan and Section of Pittsburgh Reduction Co.'s Electric Plant at Niagara Falls, With Details.

to it by a graceful stone bridge. This building will contain the step-up transformers for raising the potential from the 2,000 volts delivered by the generators to that required for high potential transmission. We need only remark here that rights of way for a pole line to Tonawanda, directly north of Buffalo, have already been secured so that it requires merely the sanction of the Buffalo City Council to bring the power into that city.

VII.

The low cost of Niagara power has already attracted some large power consumers. Among these is the Niagara Falls Paper Co. who have contracted for 6,000 H. P. developed from their own turbines, at a cost of $9 per H. P. per annum. The first to employ electric power will be the Pittsburgh Reduction Co., who will start with 2,000 H. P. volts, with one set of machines in reserve. The static transformers are mounted in pairs over a pit, and will be ventilated by a low pressure air-blast introduced from below. The Carborundum Co., of Monongahela City, have also erected works close beside those of the Pittsburgh Reduction Co., and will start with 1,000 H. P.

Having in view the growth of the population attracted by the works to be established on their property, the Niagara Falls Development Co. has reserved a considerable proportion of land for residence purposes and has already laid out streets and built a number of dwellings; a view of one of these streets is given at the foot of page 583. The sanitary works, such as water supply, sewerage system, etc., have been carefully looked to so that this new town called Echota will rank among the best equipped in the country from the sanitary standpoint.



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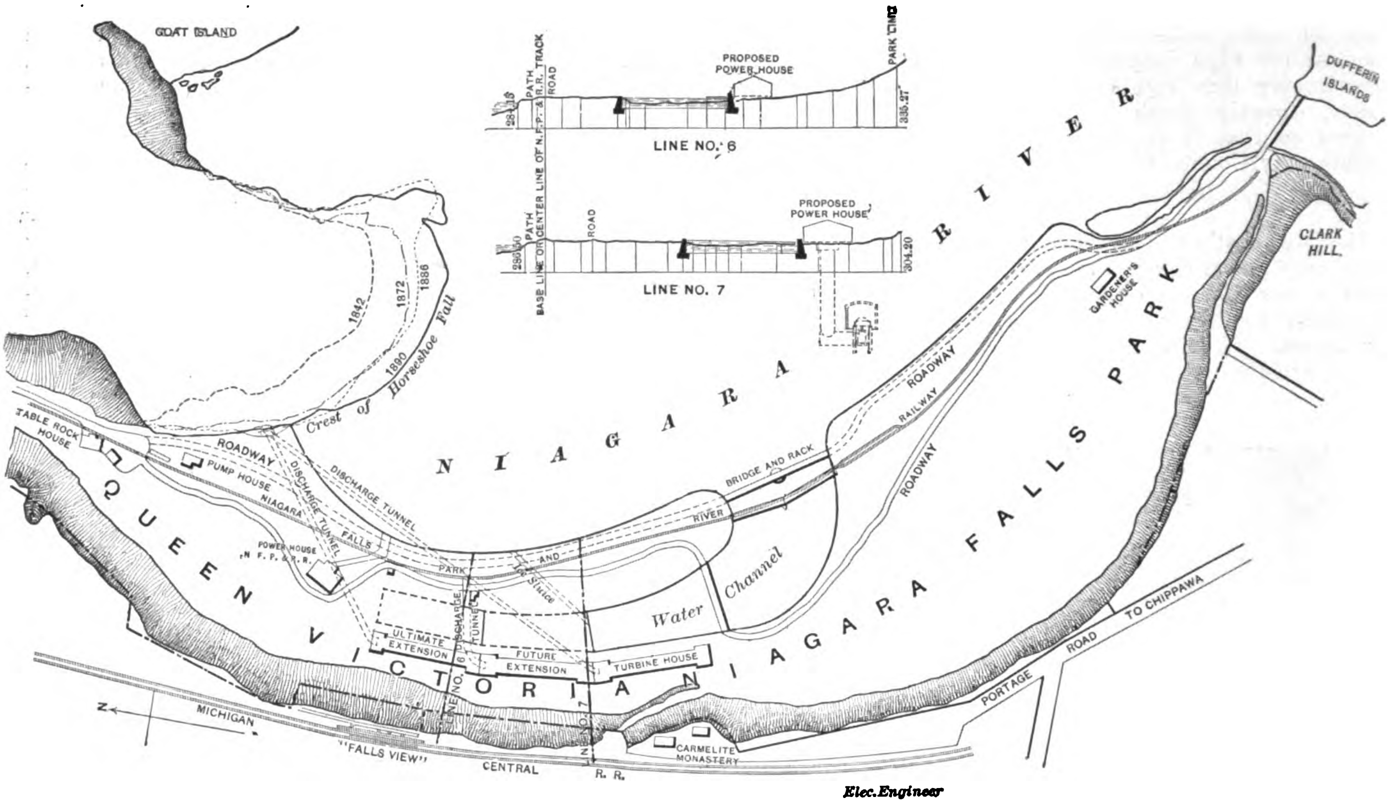
INTERIOR OF THE POWER HOUSE OF THE PITTSBURGH REDUCTION CO.

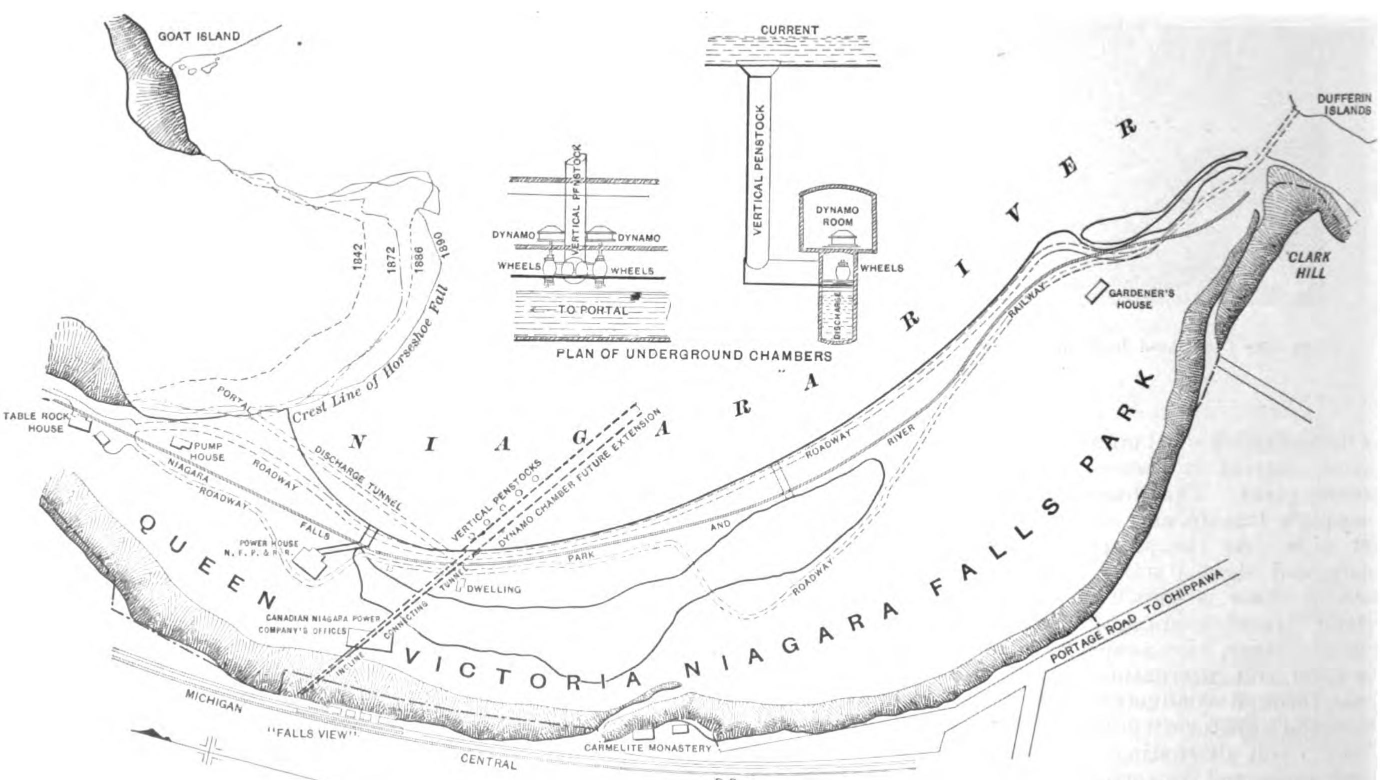
As the reduction of aluminum requires the use of the continuous current it became necessary to install a transforming plant. The illustration on this page shows the company's transformer room which is 87 feet long by 50 feet wide. At the present time there are installed four rotary and eight "static" transformers. The arrangement of these is shown in the plan on page 588. The "static" transformers, as they are called to distinguish them from the rotary, have a capacity of 200 K. W. each and receive the 2,000 volt alternating current direct from the power house through conductors laid in the conduit described above, and transform it down to 115 volts at their secondaries. This 115 volt alternating current is then led to the rotary transformers and converted into direct current at 160 volts, the pressure required for aluminum reduction. The whole plant will have a working capacity of 7,000 amperes at 160

VIII.

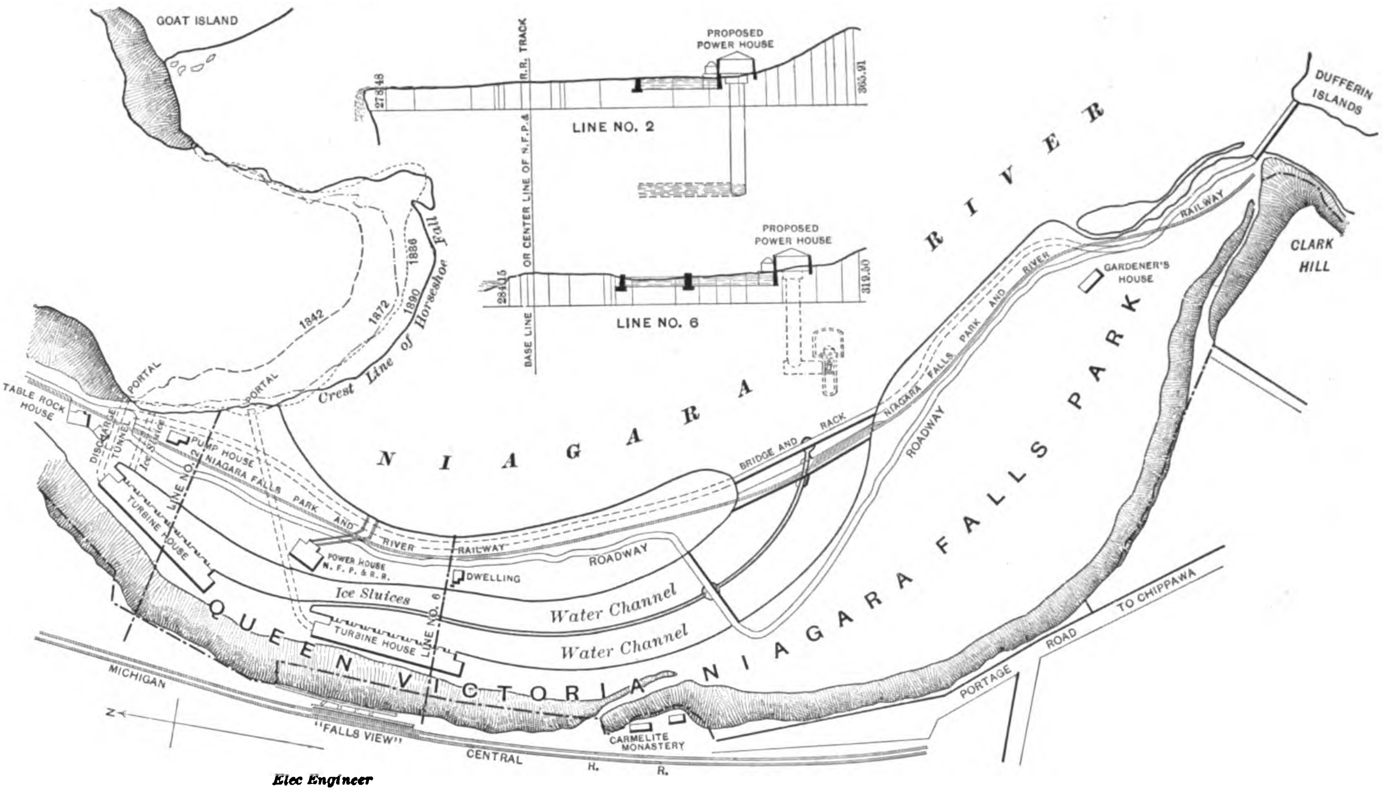
Thus far we have only considered the work done on the American side of the Falls; but, as remarked above, plans are already complete for the utilization of the Falls on the Canadian side. This work will be carried out by a company closely affiliated with the Niagara Falls Power Co., and we give on page 591 the plan just accepted by the Canadian Government for carrying out the work. As will be seen, it contemplates the ultimate erection of two power houses, with a capacity of 125,000 H. P. each, and each fed by a separate canal. The water discharged by the turbines will be carried to the outlet through tunnels having lengths respectively 300 and 800 feet, so that the great cost involved by the long tunnel on the American side will be entirely avoided. Of the other plans submitted that on page 590



Plan for One Power House and One Canal.



Plan for Placing Dynamos in an Underground Chamber.



PLAN ADOPTED FOR TWO POWER HOUSES AND TWO CANALS.

contemplated the erection of a single powerhouse with one canal. The third plan submitted and shown on page 590 was evolved by Prof. Unwin and contemplated the excavating of a dynamo and turbine room directly under the Horse Shoe Falls and a short distance back of the brink, connected to the shore by a large tunnel. By boring a vertical shaft the water would be admitted directly to the turbines placed in the dynamo room underneath. The boldness of this plan detracts nothing from its merits.

With the American and Canadian power plant fully developed there will be available 350,000 H. P., a quantity which can best be realized by stating that the total power of the stationary engines in the whole State of New York barely exceeds 500,000 H. P.

The work undertaken by the Niagara Falls Power Co. in its early stages gave rise to doubts in the minds of many as to the ultimate success of the undertaking from a financial standpoint; but no one who has given the matter close study, and having before him the evidence of the work already accomplished will now seriously venture to predict a failure; on the contrary as each new field for the utilization of the power opens up, the foresight of the promoters of the enterprise comes home with redoubled force, and enhances the credit due them as the originators of the greatest power engineering work the world has ever seen.

THE MUNICIPAL LIGHTING AND PUMPING PLANT, LEWISTON, ME.

Mr. Asa T. Green, superintendent of the city lighting and pumping plant at Lewiston, Me., informs us that an addition has been made to the equipment in the shape of a 75-light Westinghouse arc machine, with 75 arc lamps, the dynamo taking the place of an old one of the American system. The city uses 100 street lights which hitherto have been fed by two American 50-lighters. The city owns the water power, which enters from the main river through a sluiceway about 50 feet long, with a drop of about 25 feet. It is then used and returned to the river. The Risdon waterwheel is used, with a capacity of 238 H. P. The plant is run by the superintendent, two trimmers and a night patrolman.

EDUCATIONAL.

ELECTRICAL ENGINEERING AT UNION COLLEGE.

A practical course in electrical engineering is to be introduced into the curriculum of Union College, at Schenectady, N. Y. By special arrangement with the General Electric Co. students in electrical engineering will spend two months of each summer vacation in the shops of that company, at Schenectady, under the direction of the superintendents and experts in the several departments. Besides this there will be lectures and laboratory work in the regular course. At graduation the 10 students of highest standing will be awarded positions for one year, with pay sufficient for living expenses, for the purpose of further study and practice.

MORE POWER FOR HARTFORD FROM THE FARMINGTON RIVER.

The Hartford Electric Light Co. now obtains 1,500 H. P. from the Farmington River Power Co., transmitted a distance of 11 miles. The company is soon to have 2,000 H. P. more, furnished from a new dam some two miles above the present one, and giving a fall of 30 feet. Notwithstanding that the Hartford Electric Light Company, by its own desire, ceased in December last to supply power to the Hartford Street Railroad Company, the receipts of the former company were greater in January, 1895, than in January 1894. This means that there was an actual addition of new business during the year, amounting to nearly $2,000 a month. This represented the growth in the demand for electric lights and for elevator and small motor service during the year 1894. With the present increase in the general business and prosperity of the country during the year 1895, the electrical development of the present year should be considerably greater than that of 1894. The new power will become available some time during the year 1896.

DRILLING A GAS WELL BY ELECTRIC MOTOR.

The Westinghouse Electric Company will begin this week the drilling of a well for natural gas on the land in front of its immense works at East Pittsburg, and the novel experiment for using electricity for power will be made. An ordinary 25-horse power motor, such as is used in a traction car, will be placed in the engine house instead of a steam engine, and the electricity will be supplied from the works. The experiment is understood to be under the special direction of Mr. George Westinghouse, who believes great economy in drilling wells will result in the use of electricity.

ELECTRIC LIGHTING OF THE BALTIC SHIP CANAL, GERMANY.

THE opening of the Baltic Ship Canal is an event not only in marine circles, but is of more than ordinary interest to electrical engineers, owing to the magnitude and extent to which electricity is applied in the operation of the Canal. The continuous, uninterrupted lighting of a waterway over sixty-one miles in length was by no means an easy task, but this has been accomplished with the most satisfactory results in the installation carried out by the well known Helios Co., of Cologne, Germany.

FIG. 1.—MAP OF THE KIEL CANAL.

While the lighting of the Canal was one of the principal objects sought, the illumination of the locks, harbors, buildings and harbor lights was by no means a secondary consideration, and the conditions to be fulfilled were as follows. 1. The erection of two operating plants, one at Holtenau, near Kiel, and the other at Brunsbüttel, on the Elbe. (See accompanying map, Fig. 1). 2. The potential of the current must remain constant in both stations with every change of load. 3. Each light must be completely independent of every other, so that the extinction of a large number of lamps must exercise no influence on those remaining in service. 4. All auxiliary apparatus, such as main circuit regulators, oil insulation, etc., must be avoided.

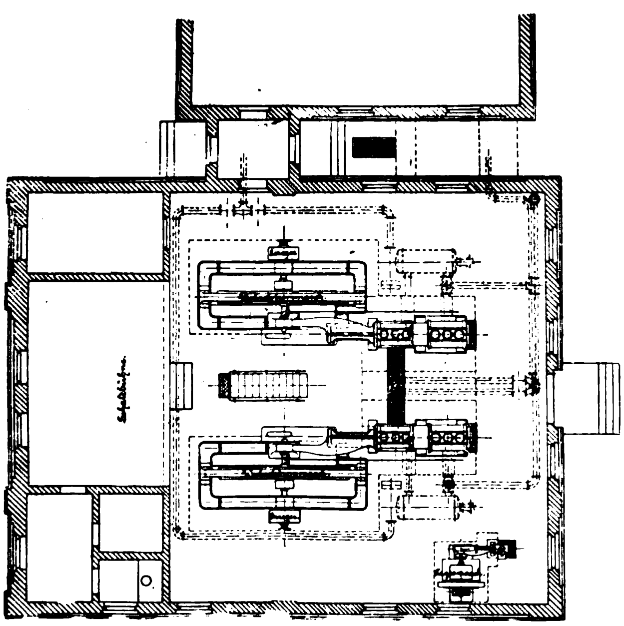


FIG. 2.—PLAN OF THE KIEL CANAL CENTRAL STATIONS.

These conditions are carried out in the following manner. At the two locks at Holtenau and Brunsbüttel central stations have been erected, the plan of each of which is shown in the engraving Fig. 2. The dynamos, of the alternating current type, are driven direct by condensing steam engines, the field magnets being bolted to the fly wheel. The number of alternations per minute is 6,120 and each dynamo has a capacity of 250 H. P. at 85 revolutions per minute. Tests have shown that this combination is capable of delivering one kilowatt to the circuits for 27.6 pounds of water per hour (20.6 lbs. per H. P. hour electric). Two of these combined engine and dynamo sets are provided for each station, one acting as a reserve. A small steam engine is also provided at each station to take the light day load.

The switches employed have been made with special care, owing to the high voltage employed, and the engraving Fig. 3 shows how they are operated by means of a crank. Triple insulation has been employed, one of porcelain, and two of hard rubber.

For the illumination of the boiler and engine rooms of the buildings, the lockgates and harbor lights, current generated at 2,000 volts at the machine is transformed down to the low potential required at the various points. The transformer employed for this purpose is shown in Fig. 4. A large number of incandescent and arc lamps are employed in this service. The lamp posts on the walls of the locks each carry four lamps, of 25 C. P. All the circuits are, almost without exception, laid under ground, and consist of concentric cables, with iron ribbon armor.

The entrances to the harbors are marked by the lights illustrated in Fig. 5. The two harbor lights at Brunsbüttel are situated at the inner extremity of the breakwater, extending far out into the mouth of the Elbe. At Holtenau the northern lights are placed in the lantern of the Kaiserhalle, while the southern light is

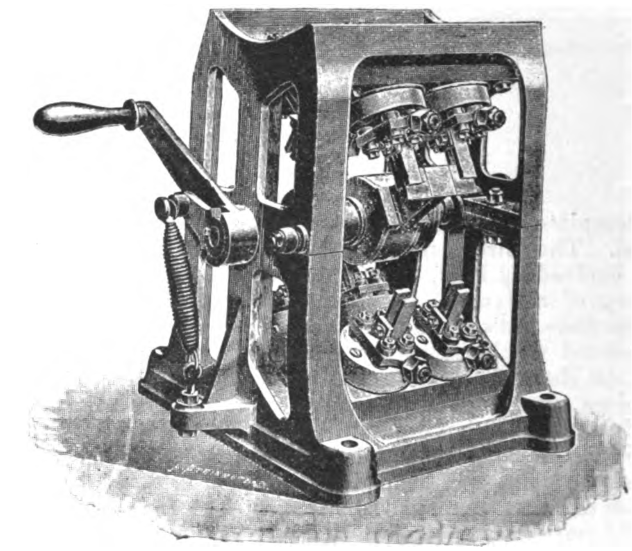


FIG. 3.—SWITCH OPERATED BY CRANK.

placed on the top of an iron tower resting on a massive stone fountain.

As stated above, the Canal is lit for its entire length of sixty-one miles, and for that purpose is divided into four sections, in such a manner that starting at the Kiel end of the Canal each section extends half way, or over thirty miles on the north, and on the south side of the Canal, respectively. At the middle point of the Canal two more sections start, one on the north and the other on the south side of the Canal, and connected to the Brunsbüttel central station. In this way four rows of lamps have been installed, for each of which a lead and return had to be provided. Beginning with Brunsbüttel the lead and return circuit on the north side of the Canal is 62 miles and the South side 62¼ miles long; while from Holtenau the circuits on each side of the Canal are each close on to 62 miles in length.

In circuit with each of these conductor divisions there are 250 incandescent lamps, of 25 C. P. each. The mean distance between one lamp and its neighbor figures out at about 196 metres, but as the lakes which the Canal intersects are not electrically illuminated (the channel in these lakes is marked by gas buoys at night) the actual mean distance between the lamps approaches close on to 177 yards. In actual practice, however, the distance between the lamps varies from 89 to 277 yards as in the straight stretches of the Canal a distance of 277 yards apart has been shown to be entirely adequate, whereas on curves the lamps are placed closer together, the main object being, of course, to give the mariner a clear outline of his course.

The Canal illuminating circuits consist of copper wire, ¼ inch in diameter, supported on heavy triple glass insulators, and carried on wooden poles placed 44 yards apart. At points where

lamps are situated the circuit is not interrupted; on the contrary, the circuit at that point is merely carried around an iron core, having a few turns of wire around it, which is put in series with the main circuit, the arrangement being as shown in Fig. 6. Parallel with this first core winding is another winding, the terminals of which are connected to the lamp filaments. The iron core of the transformer and the resistance of the incandescent lamp are so designed that of the amount of energy absorbed at each point where current is taken off, 9% is consumed in the iron core and its winding, and the remainder in the lamp. This is the

FIG. 4.—TRANSFORMER FOR KIEL CANAL.

condition when the lamp is burning. The circuit being continuous through the winding about the transformer core the burning out of a lamp, of course, has no effect on the remainder of the circuit.

The design and proportions have been so accurate that as many as ⅓ of the lamps may be thrown out of service without requiring regulation anywhere on the system in the central station. The difference of potential at each lamp amounts to 25 volts. In addition to this, considerable resistance in the conductor itself had to be overcome, so that 7500 volts is permanently maintained at the circuit terminals in the central station. This potential is reached by transforming up from the 2000 volts delivered by the dynamo. The engraving Fig. 7 shows the method of carrying the conductors and also the bracket and method of suspension of the converter and the lamp. It will be noticed that no cross arms are used, the conductors being carried on porcelain bracket insulators, and the lines are protected from lightning by barbed guard wire.

The conductors on the north side of the Canal, as well as those in the water into which the Canal empties, are buried under the Canal and consist of armored cables. These cables are sunk forty inches into the Canal bed, and consist of two inductionless rubber covered wires, reinforced with gutta percha. The armor

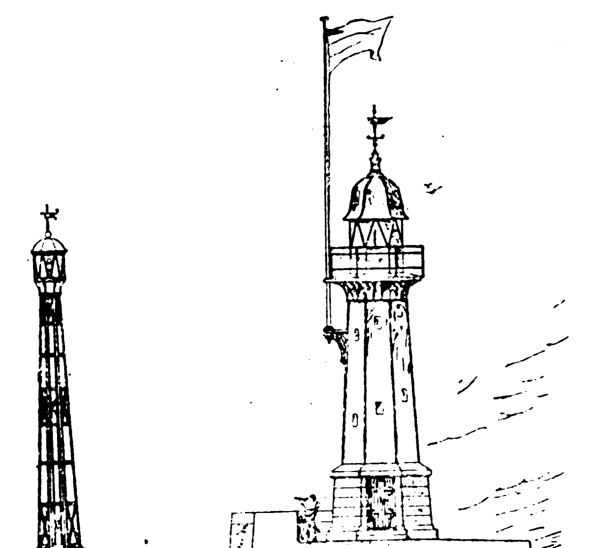
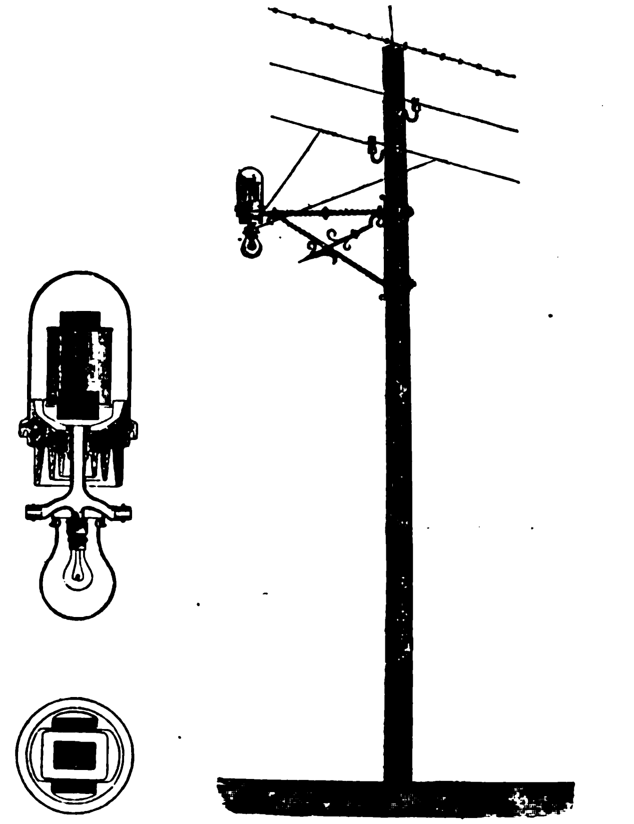


FIG. 5.—KIEL CANAL LIGHTHOUSES.

consists of galvanized iron wires. The cables were tested at 15,000 volts, so that their safe operation at 7500 volts seems assured.

Trial runs of the insulation have shown it to work without a



FIGS. 6 AND 7.—KIEL CIRCUITS AND LAMP POSTS.

hitch. For the illumination of the halls in which the festivities take place in Kiel, the central station at that point will, in addition to the illumination of the Canals and locks, deliver current for 165 arc lamps and about 500 incandescent lamps.

THE ELECTRIC CALL BELLS FOR THE U. S. HOUSE OF REPRESENTATIVES.

Mr. Edward Clark, architect of the U. S. Capitol, writes us as follows in regard to the new system of calling pages in the U. S. House of Representatives:—

In response to your request for information concerning the electric call-bell system for the House of Representatives, I beg to say, that the arrangement differs but little from the ordinary annunciator system. Two annunciators will be used, one in each cloak room at either end of the Hall. This arrangement divides the numbers of the Members' desks, into two sections, starting from the centre aisle, and provides for a total of 360 "calls." Each section being divided by aisles, permits a grouping of the return wires into one, for each portion of a desk row. On the right hand of each desk and out of the way of accidental disturbance, is placed a small push button, the face of which is flush with the surface of the woodwork. This button is connected to wires, leading through the desk legs to brass knees at the foot of the leg, used in fastening the desk to the floor. Immediately beneath these brass knees, and fixed to the floor, are copper plates which have wires running through the flooring, to a space beneath, where as often as possible they are grouped into cables suspended on suitable hangers and carried to the rooms containing their respective annunciators.

When the desks are placed in position the screws which fasten the desk to the floor, pass through the brass knees into the copper floor plates, making thereby a suitable electrical contact. Such a system of contact permits a removal of the desks at any desired time and does not require cutting of the Hall carpet.

The work named is being done by Mr. John R. Galloway, of this city.

ST. JOSEPH, MO.—Supt. Yenawine of the municipal electric light plant has asked for $28,000 for the current expenses and $15,000 for improvements, to include three 30-light dynamos and a new steam equipment.

Letters to the Editor.

THE BOYNTON MULTIVOLT BATTERY.

I have read with astonishment the reply of Mr. J. Oliver Johonnot to Professor Anthony's criticism of the "Multivolt" battery. It does not appear to me that Mr. Johonnot has proved his contention that there are no local currents in the battery. The actual construction of the battery, on which so much stress is laid, seems a practical admission of the battery's liability to wasteful local currents.

While the three couples are immersed in a common solution, it may be observed that care is taken to have the liquid communication between them of high resistance. That is accomplished by making the outlets in the carbon cylinders small, and so placing them that they are at the greatest possible distance from each other. That construction, by increasing the liquid resistance between the couples, decreases the local currents, but it certainly does not altogether get rid of them. It is obvious that the smaller the holes the less will be the loss, but, on the other hand, the circulation of the fluid—which is claimed as a notable advantage—will be correspondingly reduced.

In order to satisfy Mr. Johonnot that there is waste in the battery when on open circuit, let me suggest that between zinc of No. 1 and carbon of No. 2 he connect a galvanometer. Having performed that simple experiment he may be able to further interest the readers of The Electrical Engineer by stating the result.

Jas. W. Manson.

New York, June 15, 1895.

THE COST OF STEAM POWER IN BUFFALO.

BY HORATIO A. FOSTER.

So much has been said and written on the cost of steam power that one is naturally rather timid in approaching the subject or suggesting that he has any new ideas.

Many of the statements regarding the cost of power in the Buffalo press during the last year have been made by men quite competent to make such estimates, but who evidently did not take sufficient time to consider their statements or the effect they might have, while other estimates have been given out by persons wholly incompetent.

In making such off-hand estimates few engineers take any account of the fact that in the great majority of cases the power plant is run at an average of less than three-quarters of the rated capacity, thus increasing the fixed charge per horse-power of applied power far beyond what is usually estimated, and of course increasing the rate of fuel consumption.

Again, cost of steam power is often based largely on the rate of fuel consumption and the labor item is pretty much neglected, when the actual conditions should be reversed, as fuel cuts a comparatively small figure in a great number of cases, when all items are considered.

For instance, take a plant averaging, say, 25 horse-power, and running 24 hours per day. The very lowest this can be done for in labor cost would be for two men, who would each do his own firing, and at the low figure of $12 a week apiece, or $1,248 for the year, or $49.92 per horse-power for labor alone, while coal at $1.80 per ton costs $33.70 per horse-power; the fact being in almost all such cases that the labor cost is much larger in proportion than here stated.

The enormous waste in the use of fuel due to poor boilers, poor settings, poor selection of fuel and, above all, to poor and cheap firemen is scarcely ever considered to the extent it should be in such computations. As an exaggerated instance of waste of fuel by poor firemen, a case was brought to the notice of the writer where, in a 24-hour run on precisely the same power, the day fireman used almost exactly half as much fuel as the night man, and another instance of how close such work can be done, in which during a 72-hour continuous run the two firemen varied less than one-tenth of a pound of coal per horse-power per hour, day and night.

Again, in computing the total cost of power it is seldom the case that all the items going to make up that cost are included. The writer having had occasion to conduct a large number of tests for the purpose of determining the exact cost under actual conditions has made use of the following list of items as going to make up such cost, viz.: Operating expenses—Fuel, wages, oil, waste and supplies, repairs, water, removal of ashes, incidentals. Fixed charges—Interest on the investment in power plant, depreciation on power plant, insurance, taxes.

It is easy to obtain the cost of the operating expenses and fixed charges in almost any establishment, but it is not always quite so easy to determine the average consumption of power for a whole year, or, in fact, for any period of time more than a day. It is readily seen that any period of less than a full year, or, in fact, any period not made up of full years, is not a correct basis on which to figure, from the fact that the consumption of power is not alike in any two months of a year, and, in case steam is used for heating, of course such deductions are not alike for any two months. The writer has, therefore, always insisted on a full year's accounting, and so far has been able to determine to a very close degree of accuracy the average amount of power used.

Based on the methods outlined above, some very astonishing results have been obtained in and around Buffalo, and while it would not be proper to reveal a man's business, permission has very kindly been given by all parties for whom tests have been made to use the results. In every instance a most thorough study of the business for which power is supplied has been made, consultations held with the engineers, with the managers, and, in fact, with any and everybody from whom a scrap of information could be obtained, and in every case the results are based on conclusions arrived at in such consultations and after every point had been thoroughly discussed and agreed on both by the writer and the power-users. The plants on which such tests were made consist of two flour mills, three newspaper offices, one large bakery, one large department store, one electric light plant and three water works plants. These, for convenience, will be designated by numbers only, and not necessarily in the order named.

The following table shows the actual results obtained:

Plant No.	Average Power Used, H. P.		Hours Run P'r. d'y.	Cost Per H. P. Per An'um.
1	Between	40 and 50	24	$149 58
2	"	200 and 300	24	48 19
3	"	3,000 and 4,000	24	62 04
4	"	30 and 40	24	233 95
5	"	200 and 300	24	53 37
6	"	50 and 60	24	131 12
7	"	20 and 30	24	151 54
8	"	1,300 and 1,400	11	33 70
9	"	50 and 60	15½	76 45
10	"	20 and 30	9	108 27
11	"	10 and 20	9	173 33

As will be seen by an examination of the above table, it is practically impossible to state an average cost per hose-power, as in no two cases are the conditions alike, even though the business may be similar. In no case was selection made other than for the purpose of variety. The cost of power is governed almost wholly by the conditions of its use, and but very little by any one or two points on which great economy or efficiency can be based.

In two plants of precisely the same style of equipment and the same make of machinery, the unit cost of power per annum in one case exceeded that in the other by more than 50 per cent., simply for the reason that the first plant was doing more work with the same equipment.

In another instance, a plant in which the machinery was by no means of a modern type, was lower in unit cost of power than in similar establishments having the best and most modern apparatus, for precisely the same reason as in the last-mentioned case, added to which was the fact that, owing to special conditions, but one man was necessary.

There is scarcely a case which the writer has come across in which the cost of power can be estimated by comparison with any other case, but each plant has to be tested as if it were the only one in existence. The general result, as shown by the above table, is that steam power is costing much more than the users, or, in fact, engineers in general, have heretofore estimated.

DEPEW AND NIAGARA FALLS.

The Depew and Southwestern Railroad Company was incorporated with the Secretary of State last week to build and operate a steam or electric road from the village of Depew to the village of Blasdell, in Erie county, a distance of ten miles. The capital is $500,000 and the directors are Wilson S. Bissell, A. D. Bissell, H. P. Bissell, Martin Carey, William B. Wright, Jr., William G. Meadows, M. L. Luther, F. M. Taylor, and James Murphy of Buffalo. Wilson S. Bissell subscribes for 4,930 of the 5,000 shares of the capital stock. The Depew and Tonawanda Railroad Company was also incorporated, with a capital of $500,000, to build and operate a steam or electric road ten miles long from Depew to Tonawanda, in Erie county. The directors of the road are the same as in the Depew and Southwestern road, and Wilson S. Bissell subscribes for 4,930 of the 5,000 shares of the capital stock. It will be observed that these roads loop around Buffalo, as in the case of the Niagara power circuits.

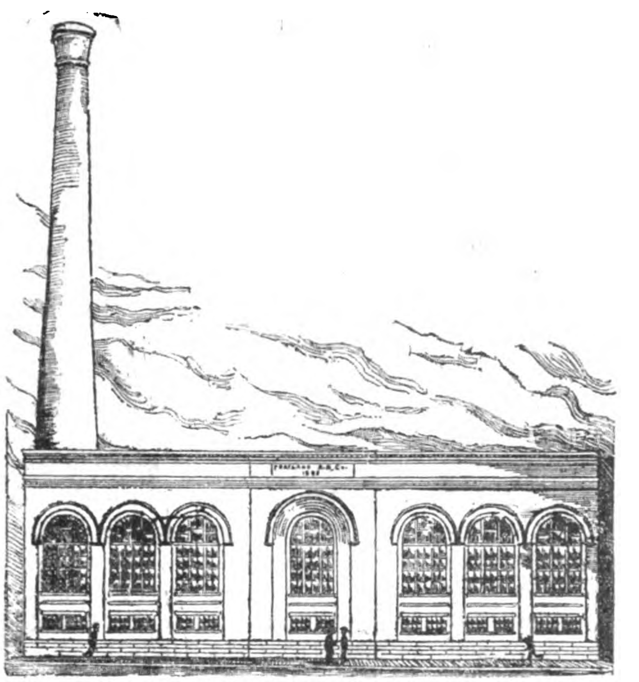
DELAVAN, WIS., DOES NOT WANT GAS.

The Delavan Light and Fuel Company mailed over three hundred circular letters to the citizens asking for opinions as to the choice of lighting systems. Four of the answers only named gas and the remainder were in favor of electric lighting. The company is now making estimates and plans for the size of plant required.

ELECTRIC TRANSPORTATION DEPARTMENT.

NEW POWER HOUSE OF THE PORTLAND, ME., RAILROAD CO.

The Portland Railroad Co. is now building its new power house, of which an exterior view is shown herewith. The foundation covers an area 113 feet by 105 feet. It is placed upon filled land, made on the mud. To secure a good base for the building 1,630 piles, each about 23 feet long, had to be driven. These piles very nearly cover the area. One foot of Portland cement concrete was placed around the tops of the piles. This will hold the piles so that they will not move laterally. It will also prevent the mud from forcing up when the great weight of the stone foundation is imposed. Upon the concrete and piles the granite foundation is placed. This foundation is laid in walls of granite three feet thick at the base and ten feet high. There are four of these side walls and a middle partition wall. There is also a solid engine bed of granite 105 feet long by 36 feet wide, and five feet high. This is to hold three engines and afford space for an extra one. The boiler foundations are five and a half feet high



NEW POWER HOUSE FOR THE PORTLAND, ME., RAILWAY CO.

and will give room for three batteries of Babcock & Wilcox boilers, each battery containing two boilers. Within the area of the building is also placed the solid granite foundation of the chimney which is to tower 145 feet above the boiler room floor. Its foundation is built 26 feet and 6 inches square at the bottom, and tapers to 16 feet and 6 inches at the top. The chimney proper will be round above the roof, the flue being six feet eight inches in diameter. At the roof it will be 13 feet 10½ inches in diameter, tapering to 8 feet 8 inches at the top. The chimney will be of brick, the core being of fire brick to a height of 58 feet. On the top will be a cast iron chimney cap.

The building itself will consist of a boiler room, an engine room and a basement under the engine room. The boiler room will be in the rear, will occupy a space 97 feet by 49 feet, and will be one story. In front of the boiler room, on the side facing Forest Avenue, is the engine room, 110 feet long by 51 feet deep. In the basement below the engine room will be the brick foundation for the engines (rising on top of the stone beneath), also condensers, steam exhaust piping, etc.

The front on the street will rise 14 feet, and will present the effect of one high story, with a high basement beneath. The windows will be large and arched. Brick with granite trimmings is the material used. The roof will be flat, supported by iron trusses. Monitor ventilations will be used. Over the engine room will be a travelling crane of a capacity of 25 tons. In one end of the boiler room will be a machine shop, offices, bath, toilet and oil rooms.

The construction is under the charge of Mechanical Engineer Frank E. Greenwood, representing Sheaff & Jaastad, the electrical and mechanical engineers of Boston, who have the superintendence and engineering of the work.

LONG DISTANCE RAILWAY WORK IN CANADA.

A special Montreal dispatch of June 19 says: An electric railway is planned to run through many of the country parishes of this province. In 1888 the Napierville Junction Railway obtained a charter to build a railroad from St. Remi, in the county of Napierville, to the town of Napierville itself. The scheme was not pushed, and the time limit of subsidies, amounting to $105,000, which had been voted by the Mercier government, was allowed to expire. Later another attempt was made to push the construction of the road, and the Dominion government voted $3,200 for each mile from St. Remi to Napierville. This subsidy expires in July 1896, and if the road is built to Napierville before the time limit expires, the government will grant another $3,200 per mile to continue the work to Stottsville.

Those interested have just corresponded with an American company to build the road, and have received a reply to the effect that if electricity be substituted for steam, and that the sum of $25,000 is voted by the different parishes through which it is proposed to run, work will begin at once. The Napierville Council has already voted $5,000, and the St. Edward Council $3,000, and it is expected the remainder will be easily obtained. Among the directors are Gen. Rielly, United States consul, Ottawa; James Fowler, United States consul at Carleton Place; and Thomas Henry, Canadian agent of the Northern Pacific Railway.

A PITHY PLEA FOR ELECTRIC BRAKES OR AIR BRAKES.

BY J. C. HENRY.

THE following is quoted from an Editorial in THE ELECTRICAL ENGINEER, under date of May 29th: "The air brake on all street car lines is as inevitable as it has proved to be on steam roads."

The same number contains a paper by Prof. Short giving his idea for a modern electric railway for suburban service, in which he includes the air brake and whistle and a number of other schemes of the writer. Some seven years ago Mr. George Lowe (now electrical expert in San Francisco), in a communication to the *Electrical World*, described an electric car I had in San Diego, California, which was stopped and started with compressed air, and which had a whistle. Theoretically, the arrangement was perfect, and away ahead of anything even now in existence. It was compact, reasonably durable, and simple. With a three-way valve we started or stopped the car, changing the leverage between the armatures and car axle so that the former could make anywhere from 10 to 100 revolutions to one of the latter. In addition to this the compressed air assisted the armature in getting the car under headway. Those who are familiar with the constant running armature system I used in the West during the years from and including '85 to '89 will understand the scheme if they imagine an air pump being substituted for the friction clutch which surrounded the differential internal gear. While the air brake and whistle part were entirely satisfactory, the balance was not, as we were unable to make pistons, valves, and pipe joints that would not leak. This fault was fatal as far as the variable features were concerned.

While I fully agree with the opinions quoted, as the art now stands, and think it criminal to operate street cars without them, I am decidedly of the opinion that the days of air brakes are numbered on all kinds of cars. From the experiments I have made and study I have given the subject I am satisfied the solution is in the proper design of electric brakes.

On many of the electric cars now in use there is no room for the pumps on the axle. The air brake systems now on the market have all of the parts of a stationary steam power plant, i e., they have a pressure reservoir, cylinder, piston, valves and pipe systems. They are reliable, but probably as expensive as a good motor to keep in repair. The ideal electric brake will not depend on the line current, it will be frictionless, and the retarding force will be proportionate to the speed of the cars.

BOSTON WEST END.—Mr. E. E. Higgins predicts that probably within the next two years the West End system will develop an earning power of $7,500,000 gross and $2,250,000 net; leaving about $950,000 applicable to dividends on common stock.

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EDITORIAL ANNOUNCEMENTS.

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Communications for the Editorial Department should reach it not later than Thursday. Copy for advertisements should be handed in not later than Friday

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CONTENTS.

THE ELECTRICAL ENGINEER DATA SHEETS.

EVERY worker in the electrical field has a desire to compile Data that bears directly on his line of study or practice. The usual method is to enter this data in note books. But the earnest compiler will soon find that his note book is full, and in order to keep his data up to date he has to start over again, and write up a new note book, copying all the data that is still alive from the old note book. This process, as a rule, keeps on indefinitely, involving a large amount of work, with rarely satisfactory results. It is impossible, moreover, for the electrician to carry the formulæ and constants in his mind, where his work covers any large range of electrical engineering. Even in an attempt to carry this, the mind is not left free to consider, with its full clearness, the details that arise in daily practice. The value of an engineer to his profession is not so much what he remembers, but to have the general knowledge which will enable him to refer to any desired information.

With the object of assisting its readers to overcome and avoid the difficulties above referred to, in the accumulation of important and necessary data, THE ELECTRICAL ENGINEER has arranged with Mr. Albert B. Herrick to edit a series of copyright Electrical Engineering Data Sheets, which will appear as supplements to its pages, and the first of which accompanies this issue. In taking this step, the ENGINEER makes a distinctly new departure in technical journalism, and one which it has reason to believe, will be very highly appreciated, not only within the electrical ranks but outside. The plan adopted in the publication of this data involves a great many novelties, some of which will be apparent at once and others of which will reveal themselves in due course. In order, for example, that the mass of information which is useful to the electrical engineering profession be compiled in such form as to be of the greatest utility, it should be subject to a logical and complete index. An alphabetical index is not sufficient to meet the close classification that is required in this class of data. In order to include without confusion the minutiæ of the details involved in the exact classification, it has been found best to classify the data numerically. As shown in the Data Sheet Supplement accompanying this, the first digit represents the general class ; the second digit represents the fundamental subdivisions of this class ; the third digit represents the subdivision of the fundamental classification ; the fourth digit represents the minor divisions of the topic, which it has been deemed unnecessary to expand in the general classification of data, on the sheet published with this issue.

Some of the advantages of this method of indexing are that this matter can be issued periodically. The numbers on each data sheet, which are always on the upper left hand corner, will require the data to be filed in logical order, and the topics to be graded and blended into each other, so that, when the series is complete the data sheets will be in their proper order. For instance, a Data Sheet bearing the number of **5873** will be only such data as relates to electrical appliances used on three-phase switchboards ; the first digit five standing for electricity, the the second digit eight for appliances, the third digit seven for switchboards and the fourth digit three for three-phase.

5515 will be data which pertains to running values on continuous current generators determined from tests and calculations. The first digit five stands for electricity, the second digit five stands for dynamos, the third digit one stands for continuous current generators, and the fourth digit five stands for running values determined from tests and calculations. It will be noticed that in the index sheet none of the subdivisions are completely filled, allowing a margin for extending the system to meet future requirements. For convenience, the Data Sheets are published four at a time, printed on heavy bond paper. These are to be cut up, and will then be of uniform size to fit into the Data filing case, which it is proposed to furnish.

The flexibility of this system is evident. Data Sheets bearing a given number can be supplanted by data of a more recent date.

To make this system of greater use to the electrical engineer in his daily duties, the case has been made convenient for the pocket, and large enough to easily hold 200 of these quarter sheets. The engineer can at any time select such sheets of Data from the published sheets as will apply directly to his work, and, in this way, carries around only such information as will be of immediate use to him.

The scope of this Data is intended to embrace a vast amount of standardized information bearing directly on the subject of electrical engineering. It will also be within the scope of this Data to give the sizes, dimensions, weights and other useful information regarding standard forms of appliances, machinery, and materials of electrical engineering, which will bear directly on the work of the constructing engineer. These will be revised from time to time to keep in touch with the most recent progress of the manufacturers. This engineering data will also embody a great deal of original work on the part of the editor to fill in gaps where information is lacking, and in many cases, to change the form of existing information to make it comprehensive and of more utility to the practical worker.

The question of the exact time and also the progress that any branch of the art had made at the period when the data was compiled, will all have a bearing on the weight one must give it in applying it to present needs. There is a *moral hazard* that the student or engineer will often accept printed information or data as having a veracity that should not be attributed to it. It has therefore been decided to rate every sheet of data with a letter that will indicate to the engineer the amount of dependence that should be placed on the information in it. For this purpose all this information has been divided into three grades, and a letter put in the upper right hand corner to indicate the relative value. "A" means that the data is correct. "B" means that it is approximately correct, and "C" that its accuracy is a little doubtful. By giving a figure of merit in this way to the information, its actual value becomes greater, and will not lead students or practitioners into the error of applying approximate, for absolute, results.

As this method of disseminating knowledge is mutual, any assistance in the way of suggestions, forms of topics or corrections in this system will be thankfully received by the editor of these sheets, and, in all cases, where proper credit will be given. It is the purpose to give frequent references so that the student can immediately refer to the sources of information bearing directly on the topic. The scope of this work will be comprehensive enough to aid all workers and students in the electrical field, or allied arts.

These Data Sheet Supplements will appear frequently, though with no specific regularity or periodicity, and will be obtainable only with and as a part of the issue of THE ELECTRICAL ENGINEER in which publication occurs. In other words, they will not be sold separately. The management of the ENGINEER will greatly appreciate the help of its friends in this novel work, which it believes likely to be of great value and importance to all branches of the profession.

NIAGARA.

In view of the visit of the Electrical Engineers to Niagara this week, we have deemed it timely to prepare a brief illustrated review of the work done for the purpose of utilizing the power of the Falls by means of electricity. We have also supplemented that by the plans, now shown for the first time, that have been submitted for the utilization on the Canadian side. Our readers will find this article to give a summary of the main features of this great engineering enterprise which is to place nearly half a million horsepower at the command of all the industries of northern New York and more particularly of those in the immediate vicinity of Niagara Falls.

It seems to us that nothing since the opening of the Erie Canal has been of more importance to New York State than the completion of this great enterprise. The time of preparation has perhaps appeared long to the doubting, but after all six years is a short space when the magnitude of the undertaking is borne in mind. At Niagara we have the overflow of four inland seas of an area of 90,000 square miles and receiving the natural drainage of 250,000 square miles, and the problem was not only to use the power to the best advantage but to do as little as possible to lessen the wonderful beauty of the river, the cascade and the gorge. In all these preliminaries, the engineers and experts engaged have scored a great success, and we believe that the conservative management of the enterprise has ensured a brilliant reward in the future for the enlightened investors who seized this opportunity.

Part of the work is done; and as our diagrams show, the other part is about to begin over on the Canadian shore, where the second great utilization is to be attempted. It will meantime be interesting to witness the development of the Niagara region under this new stimulus and to study the results in electrical transmission. The enterprise affords in this respect a noteworthy object lesson, every detail of which will be closely studied. While there may be some minor disappointments, and some unexpected evolutions, we do not hesitate to express our firm conviction that the work will prove itself to be one of the greatest engineering feats of the nineteenth century, as well as one of its most successful applications of capital on a large scale to the exploitation of natural forces.

THE lighting of the Baltic Ship canal by electricity, as described in our pages this week, exemplifies again the flexibility of modern electrical methods of illumination. The canal is over 60 miles long, but is lit from two plants in an ingenious and very effective manner.

TELEPHONY.

THE RESURRECTED BERLINER PATENT.

BY C. C. SCHUYLER.

I CANNOT see why the progress of telephony in the United States should suffer any serious set-back as a result of the recent decision of the U. S. Circuit Court of Appeals.

My reasons for thinking that the position of the American Bell Telephone Company, namely, that the Berliner patent "covers all forms of microphone transmitters or contact telephones," is not tenable, are as follows:

Edison filed his application for a "Speaking Telegraph" April 27, 1877, Berliner for a "Combined Telegraph and Telephone" June 4, 1877. In these applications both show *electrodes in constant contact;* both show apparatus for causing electrical undulations by varying the resistance in an electrical circuit in which a current is passing; neither can be made to transmit spoken words unless the electrodes are in contact, and they must be in *constant contact* to be serviceable.

Edison claimed, "In a speaking telegraph transmitter, the combination of a metallic diaphragm and disc of plumbago, or equivalent material, the contiguous faces of said disc and diaphragm *being in contact;*" Berliner, "The combination with the diaphragm and vibrating electrode of a rigidly held opposing electrode in *constant contact* with the vibrating electrode." Now, "*being in contact*" is certainly in "*constant contact*" in this instance, as both show a rigidly held opposing electrode.

Berliner claims (claim 1) "the method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact * * * thereby increase and diminish the resistance of the current." Why did not Edison claim this? Because, while he may, and probably did, independently discover this peculiarity of conducting bodies in contact, he probably learned that years before Du Moncel had announced "that the increase of pressure between two electrodes in constant contact produces a diminution in their electrical resistance." Edison in his specification refers to this fact, and without doubt he very well knew that his transmitter demonstrated the fact. Berliner was granted a patent Nov. 17, 1891, and, undoubtedly, appreciating the fact that this patent did not cover *carbon* electrodes, and controlling both the Berliner and Edison applications, the American Bell Co. hastened to put through the Edison patent, which was granted about six months later, and which, as was supposed, covered the use of carbon.

Edison's transmitter was in practical use in 1878. Moreover, a careful perusal of the files in the Berliner case in the Patent Office (which, by the way, were kept for a long time under lock and key), shows that, practically, the only resemblance that the final amended and re-amended specifications bore to the original, was the words "combined telegraph and telephone" and the signature, Emile Berliner!

Setting aside these facts, the one unsurmountable obstacle which the Bell Company will probably run against in their efforts to maintain their monopoly, is, as the ENGINEER has already stated, the British Patent No. 91, of 1880, which Berliner, through his agent Lake, took out for a microphone, in which a *movable* electrode is *held against* a *stationary one by gravity.* This patent expired in 1894.

And, too, the fact should not be lost sight of that in the Berliner patent is shown a device of a *metal ball* and *metal plate,* not carbon, which device those familiar with telephony well know, is not practical.

As has been stated in your journal, there are several excellent transmitters now on the market to which the claim of Berliner does not apply.

PLATTSBURGH, N. Y.

THE TELEPHONIC SOUND PRODUCED BY THERMIC RADIATION.

M. Semmola shows in *Comptes Rendus* that on causing intermittent solar light to fall, by means of a lens, on the gilded metallic plate, 2mm. thick, of a Hunnings microphone, the telephone put in circuit produces a slight but very distinct sound. If the luminous ray be supressed, the sound ceases. The intensity of the sound increases or decreases according as the intermittences of the radiation becomes more or less rapid. The best radiations are the thermic radiations, as the sound is louder when the metallic plate is coated with lamp-black. On the other hand, the sound is no longer heard when the luminous pencil traverses non-thermal substances before reaching the microphone. It is necessary that the tiny image of the sun which is formed in the focus of the lens, and which strikes the vibrating plate, should be fairly hot and capable of at least carbonizing paper. It seems, then, that the plate suffers rapid and regular dilations and contractions which determine the thermic vibrations.

WESTERN UNION MEN TURNED OUT OF THE PHILADELPHIA BELL TELEPHONE CO.

At a meeting of the Board of Managers of the Bell Telephone Company of Philadelphia on June 18 Messrs. Merrihew, Gill, Tinker, Clark, Westbrook and Plush, who represented the Western Union interests, resigned, and C. J. French and Thomas Sherwin, of Boston, Mass.; Francis B. Reeves and Joseph E. Gillingham, of Philadelphia; J. King Goodrich, of Pittsburgh, Pa., and Edward J. Hall, of New York, were elected to fill the vacancies.

John E. Hudson, of Boston, was elected president; A. A. Ziegler, of Philadelphia, treasurer, and Samuel B. Huey, of Philadelphia, secretary and solicitor.

The retirement of all the Western Union stockholders except General T. T. Eckert was a surprise. Mr. Merrihew was president, Mr. Gill vice-president and Dr. Plush general manager. It is alleged that the retirement of the Western Union men is amicable, but this is not believed for a moment by those who know of the existing conditions. Mr. Merrihew has been an active president and Dr. Plush has made the telephone the study of his life. It now remains to be seen whether the Western Union men will operate an independent exchange in Philadelphia.

3,400 CONTRACTS FOR THE BALTIMORE HOME TELEPHONE CO.

The following item from the *Baltimore News* of June 8 is of not a little interest:—

An interesting and unique ceremony will be held at the office of the Maryland Trust Company, at the corner of German and South streets, to-morrow afternoon at 1.30 o'clock. It will be the counting of the contracts of the new Home Telephone Company, which is establishing itself in Baltimore. It has 3,400 contracts with citizens of Baltimore to take its telephone service for three years at $36 and $48 a year, and it will have a public counting of contracts to show the people it means business.

About 50 invitations have been issued and lunch will be served at the Equitable Café to those having invitations immediately after the counting is completed. Among those who have been asked to do the counting are Governor Brown, Mayor Latrobe, Postmaster Warfield, Mr. E. F. Abell, General Felix Agnus, Mr. Douglas H. Gordon, Mr. J. Willcox Brown and Mr. B. F. Newcomer. General Manager Parmlee of the Chesapeake and Potomac Telephone Company was by some misfortune overlooked when the invitations were sent out.

In explanation of the matter United States Attorney Marbury of counsel for the company, said this morning: The managers of the company thought that, inasmuch as the public was being asked to subscribe to the telephones and some of the company's stock was about to be offered for sale, the public was entitled to know and to see for itself what the company has already to offer and to judge of its future prosperity. The company is now considering proposals for the erection of its system in Baltimore.

The Home Telephone has purchased a franchise which gives it full right to extend its wires through the streets and conduct a telephone business in Baltimore. This franchise was originally secured from the Maryland Legislature for the Writing Telegraph Company, in which the Abells were interested. This company was formed for the purpose of applying a patent to reproduce writing by electricity, but it never did any practical work and the projectors sold the franchise to the Home Telephone Company. Among Baltimoreans who will be directors of the new telephone company are: Messrs. Alexander Brown, Walter B. Brooks, Bazil B. Gordon, Lloyd L. Jackson, W. H. Bosley of John S. Gittings & Co., and Henry King of Henry King & Son.

TELEPHONE NOTES.

ROCHESTER, N. Y.—Capitalists of this city have asked for a telephone franchise.

SPARTA, WIS.—A telephone line connecting Sparta and Cataract, thirteen miles north, is soon to be built by D. W. Cody, proprietor of the stage and mail line.

RICHMOND, VT.—The Richmond and Huntington Telephone company has organized under the laws of Vermont. The following officers were elected: A. E. Ellis, president; J. C. Sabins, secretary; F. B. Gillette, A. E. Ellis, W. E. Hanks, directors; A. Hanks, auditor. The company has a capital of $15,000.

TAMPA, FLA.—The Citizens' Telephone Company of Tampa is now an assured fact. The officers for the year have been elected as follows: S. J. Drawdy, president; A. C. Clervis, vice-president; John Trice, treasurer; C. H. Keller, secretary and general manager.

WASHINGTON, D. C.—A company to be known as the Columbian Standard Telephone Company has been organized in this city, with L. G. Hine as president, Felix Agnus, vice-president, and George W. Cross as general manager. The company is to operate in Maryland, the District of Columbia, Virginia and West Virginia.

SOCIETY AND CLUB NOTES.

PROSPERITY OF THE NEW YORK ELECTRICAL SOCIETY.—INSPECTION OF THE LENOX AVE. CONDUIT ROAD.

John W. Lieb, Jr.

The annual meeting of the New York Electrical Society was held on June 18 at the power house of the Metropolitan Traction Co., on Lenox avenue and 146th street. Secretary G. H. Guy read a report showing the society to be in a most flourishing condition with 370 members, a gain of 20 over the preceding year. President Mailloux gave notice of a motion to amend the by-laws to the effect that only the secretary and treasurer should be eligible for immediate re-election. The following were then elected as officers for 1895-6: President, John W. Lieb, Jr.; vice presidents, H. L. Webb, E. Caldwell, F. Forbes, N. W. Perry, Prof. L. H. Laudy, Prof. Morris Loeb; secretary, G. H. Guy; treasurer, H. A. Sinclair.

The attendance was large. After the business had been quickly dispatched, the members inspected the power house and then took a ride out upon the road. Upon returning to the station, Mr. L. J. Hirt, assistant chief engineer of the Metropolitan Traction Co., delivered a most interesting address upon the underground conduit system on Lenox avenue, installed by the General Electric Co. He showed that a number of improvements had already been made in the methods used, and illustrated his remarks with drawings, models and actual appliances, such as insulators, plows, &c. He was listened to with the utmost interest. The meeting closed about 10 p. m.

Mr. Lieb, the new president of the Society, is an M. E. graduate of the Stevens Institute of Technology. He spent six months as a draftsman in the old Brush works at Cleveland, and in 1881 joined the engineering department of the Edison Electric Light Co. He went all through the early stages of the Edison electric lighting development, and was the first electrician of the first Edison central station in New York. In 1882-3 he was sent to Milan, Italy, to organize and carry on the plant of the Edison Electric Light Co. of that city; and there he remained for some years directing the work, which included extensive systems of overhead and underground wires, and plants of the Edison, Thomson-Houston and Zipernowsky-Deri apparatus. In 1894, he resumed work with the New York Edison Co. by becoming its assistant general manager. Mr. Lieb is also familiar with electric railway work, especially that done in Europe. He is a member of the Italian Society of Electricians, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

ELECTRICAL ENGINEERING LABORATORIES.

The equipment for electrical engineering laboratories is ably discussed by Dugald C. Jackson, professor of Electrical Engineering, at the University of Wisconsin in a paper read before the Society for the Promotion of Engineering Education. The subject is concisely and effectively covered. The key note of the pamphlet is given in one of its concluding sentences: "Laboratory courses are likely to fail when not properly balanced, on account of a failure to educate the common sense or judgment of students, and the students leave the college without having gained an all-round capacity for practical work and research, which is necessary to put them in a fair way to become useful engineers."

ELECTRICITY AT THE BALTIMORE EXPOSITION.

It is probable that the electrical building of the Baltimore Centennial Exposition will be placed on the highest point of land in Clifton Park, at what is known as Tip-Top Place, situated in the northwest corner of the park, near the Harford road. This spot is 245 feet above tidewater, and the upper portion of a building placed there, lit by electricity, can be seen from points 15 to 20 miles distant in every direction. The most powerful searchlights yet constructed will be placed in the tower of the electrical building, and the light thrown into every nook and corner within range on the Patapsco and Chesapeake.

Electrical experts have recommended that the large dynamos and heavy electric machinery be placed in the Machinery Building, reserving the Electrical Building for devices operated by transmitted power. It is expected that a magnificent display of electric illuminants will be made around Lake Clifton bordering the roadway. The effects of this display will be greatly enhanced by the reflected lights on the lake's surface.

REPORTS OF COMPANIES.

THE BALTIMORE BRUSH CO.

Mr. George Westinghouse has been elected president of the Brush Electric Company, of Baltimore. He succeeds Mr. Summerfield Baldwin, who has been president of the company fourteen years, with an intermission of one year. The other directors elected at a meeting of the stockholders in the Merchants' Bank Building were: Dr. William Whitridge, who was made vice president; Summerfield Baldwin, Edgar G. Miller, Francis E. Waters, James E. Hooper, Lloyd L. Jackson, G. W. Hebard and George H. Blakistone. H. C. Tudor was elected secretary and treasurer of the company.

BROOKLYN EDISON CO.

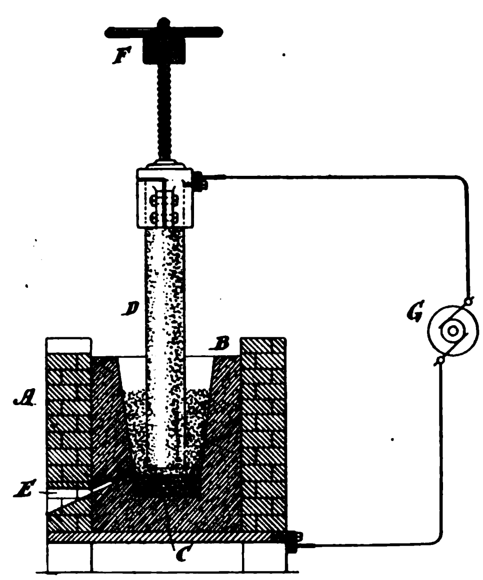
At a special stockholders' meeting of the Edison Electric Illuminating Company of Brooklyn, the capital stock of the company was increased $750,000 to $3,750,000. The directors were authorized to issue additional bonds to the amount of $500,000 for the purpose of purchasing the capital stock of the Citizens' Electric Illuminating Company and for extensions of the combined plants.

WILLSON'S PROCESS FOR PRODUCING CALCIUM CARBIDE BY ELECTRICITY.

THE accompanying illustration shows the electric furnace designed by Mr. Thomas L. Willson, of this city, and used in connection with his new process of manufacturing calcium carbide, now so well known.

The furnace A is provided with a carbon lining B, a conducting pole C of broken carbon and a removable pole D of compact carbon. E is the tap hole for removing the melted product. The distance between the poles is regulated by means of the adjusting mechanism F.

Very finely divided coke and lime, mechanically reduced to a powder are mixed in the proportion of thirty-five per cent. of coke and sixty-five per cent. of lime. The carbon pole D and the conducting mass C of the furnace are connected to the poles of an alternating current dynamo having a mean potential of fifty-five volts. Under these conditions, by reason of the alternation of the current, a feeding in of the mingled lime and carbon between the poles is effected to an extent which does not occur when a direct current is used. The action is purely a smelting action and the block of molten calcium carbide which forms beneath the elevating pole is itself a good conductor of electricity and can be built up from the bottom to any desired height without preventing the operation of the process. By this process the yield of calcium carbide per electric horse power is claimed to be almost doubled over a process of using a direct current, while, at the same time, the process proceeds uniformly and without break, by reason of the substantial uniform feeding in of the material. The action of the alternating current produces a series of explosions, the effect of which seems to be to feed the pulverized material into the arc, accomplishing a rapid and uniform conversion. The current alternates about 50 times a minute.



WILLSON'S CALCIUM CARBIDE PROCESS.

Inventors' Record.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 18, 1895.

Accumulators:—

Storage Battery and Method of Making Same, N. H. Edgerton, West Whiteland, Pa., 541,081. Filed Feb. 27, 1894.
The object is the reduction of weight, by substituting the use of very light and compressible gases evolved from the electrolyte by the charging current, for the heavy lead oxides.

Alarms and Signals:—

Repeater, M. G. Crane, Newton, Mass., 541,225. Filed Aug. 4, 1894.
A non-interfering repeater for fire alarm circuits.
Electric Train Signal, E. J. Devine, Port Arthur, Canada, 541,389. Filed Dec. 11, 1894.
Means for indicating at each end of a train when there is a parting or breaking between any two of the cars.

Conductors, Conduits and Insulators:—

Insulator, J. M. Patterson, Springtown, Texas, 541,382. Filed Apl. 10, 1895.
Insulator for suspending barbed wire used for electric conductors.

Distribution:—

System of Electrical Distribution, C. K. Huguet, New Orleans, La., 541,233. Filed Jan. 30, 1895.
The object is to supply to each of one or more different branch circuits an alternating current of constant strength, from a source of alternating currents of constant potential.

Dynamos and Motors:—

Compound Wound Alternating Generator, J. D. Hilliard, Jr., Bluefield, W. Va., 541,357. Filed June 21, 1894.
Puts two windings on the field spools of the generator, one of which is furnished with a constant current from a separate exciter, and the other with a variable current supplied by the generator itself and varied with the variation of the load of the generator.
Armature for Electric Motors and Generators, J. F. McLaughlin, Philadelphia, Pa., 541,380. Filed Dec. 5, 1891.
The conductors are embedded in slots and the periphery of the armature is wound longitudinally with iron wire.

Electrometallurgy and Electrolysis:—

Calcium Carbide Process, T. L. Willson, New York, 541,137. Filed Jan. 16, 1895.
For description see page 599 this issue.
Product Existing in Form of Crystalline Calcium Carbide, T. L. Willson, New York, 541,138. Filed March 4, 1895.
As a new product, crystalline calcium carbide existing as masses of aggregated crystals.
Electrolytic Process and Apparatus, H. Blackman, New York, 541,146. Filed July 2, 1894.
The improvement in electrolytic processes, which consists in first cooling the electrolyte, then introducing it to the cell, and then subjecting it to electrolysis and again cooling it during the electrolysis.
Process of and Apparatus for Bleaching, H. Blackman, New York, 541,147. Filed June 28, 1894.
The process of bleaching consisting in first electrolysing a solution of a chloride of an alkali or alkaline earth, heating the electrolyte containing the resulting hypochlorite and bleaching with it while at an elevated temperature, then cooling it and again electrolysing it, whereby the bleaching is performed at a high temperature and the electrolysis at a low temperature.
Process of and Apparatus for Disinfecting and Purifying Water, C. Salzberger, Burgsteinfurt, Germany, 541,335. Filed Feb. 24, 1894
Process consists in first mixing the water with lime paste to purify it; then charging the mixture with carbon dioxide, and then subjecting the mixture to the action of an electric current to separate and set free the carbonate of lime and the carbon dioxide.

Galvanic Batteries:—

Portable Galvanic Battery Cell, X. F. A. Glasgow, St. Louis, Mo., 541,350. Filed Sept. 18, 1894.

Lamps and Appurtenances:—

Device for Conducting Electricity to Lamps, &c., G. F. Rose, London, Eng., 541,121. Filed Feb. 27, 1895.
For electric lighting on dining tables, sideboards or other analogous places, flat conducting strips and contact devices consisting of spikes and metal brushes or webs for connecting the lamps thereto.
Electric Arc Lamp, C. A. Pfluger, Chicago, Ill., 541,179. Filed July 2, 1894.
The carbons are inclined to each other at an acute angle and supported in tubes controlled by a solenoid magnet.
Arc Lighting, S. W. Rushmore, Brooklyn, N. Y., 541,290. Filed Mch. 20, 1895.
For description see THE ELECTRICAL ENGINEER, June 12, 1895.

Measurement:—

Current Strength Indicator, P. G. Burgess, Boston, Mass., 541,148. Filed Mch. 25, 1895.
Details relating to battery cell tester, etc.

Miscellaneous:—

Electric Elevator, R. Eickemeyer, Yonkers, N. Y., 541,200. Filed Oct. 1, 1890.
Employs storage batteries in connection with the main source of supply to prevent heavy fluctuation on the main circuit.
Apparatus for Steering Vessels, W. R. Moore and W. Megarvey, Cleveland, Ohio, 541,236. Filed Feb. 23, 1895.
Means for indicating on a vessel being towed the change in the course or direction of a steam boat while towing another vessel.
Electric Stop Motion for Engines, E. C. Myrick and G. C. Doeg, Providence, R. I., 541,287. Filed May 23, 1893.
Consists of a magnet, attached to the valve gear of engines of the Corliss type, which shuts off the steam when energized.
Electric Truss, B. R. Lathrop, Weedsport, N. Y., 541,367. Filed Aug. 27, 1894.

Railways and Appliances:

Electric Car Brake, G. B. Damon, Lowell, Mass., 541,073. Filed April 30, 1894.
An electric valve controls air pressure by which the brake is applied.
Crossing for Trolley Wires, J. Kroger, Pleasantville, N. J., 541,098. Filed Nov. 3, 1894.
For description see THE ELECTRICAL ENGINEER, May 15, 1895.
Electric Railway, R. M. Hunter, Philadelphia, Pa., 541,165. Filed Jan. 12, 1887.
The combination of the car body, the axles and wheels therefor an electric motor having its shaft connected with the axle by a hinged frame, a power transmitting connection between the motor shaft and axle, and an elastic support for the motor permitting it to rise and fall bodily while maintaining the transmitting connection with the axle.
Rail Bond, W. E. Baker & H. M. Brinckerhoff, Chicago, Ill., 541,259. Filed Mch. 11, 1895.
The bond is reversely bent.

Underground Closed Conduit System for Electric Railways, A. J. Smith, Milwaukee, Wis., 541,338. Filed June 6, 1894.
The object is to provide a single conductor to serve for both tracks, to prevent electrical induction, and also means for making and breaking contacts quickly.
Electric Alarm Signal and Indicator for Trolley Railroads, J. A. Buisson, New Orleans, La., 541,341. Filed Apl. 2, 1895.
The object is to provide a simple and effective signal and alarm for crossings, curves and other dangerous places on a trolley railroad.

Switches, Cut Outs, etc.:—

Rheostat or other Circuit Controller, C. Willms, Baltimore, Md., 541,136. Filed Nov. 26, 1894.
Details of construction.
Electric Switch, C. P. Elieson, London, Eng., 541,227. Filed July 16, 1894.
A tipping mercury switch.
Push Button, F. W. Manger, Brooklyn, N. Y., 541,243. Filed Oct. 1, 1894.
Provided with a washer at the base and a flexible disc covering the button, so as to exclude all moisture.

Telegraphs:—

Transmitter, J. Burry, New York, 541,149. Filed Oct. 23, 1893.
The invention relates to telegraph transmitters of the well-known sunflower type, and more particularly to the mechanism for operating the trailer which coacts with the sunflower; the objects being to control the action of the trailer with certainty, and to increase the speed of transmission.

Telephones:—

Telephone System, W. W. Dean, St. Louis, Mo., 541,077. Filed Feb. 21, 1895.
Provides means whereby a single battery at the central station may be employed for supplying the current to all of the subscribers' transmitters.
Distributing Frame for Telephone Circuit Conductors, F. B. Cook, Chicago, Ill. 541,152. Filed Jan. 9, 1895.

Legal Notes.

DISMISSAL OF THE DILLON COMPLAINT AGAINST THE COMMERCIAL CABLE CO.

THE General Term of the New York Supreme Court has sustained the judgment of the trial court in dismissing the complaint in the suit brought by Count Arthur Dillon against the Commercial Cable Company as a corporation, and John W. Mackay and James Gordon Bennett, for the recovery of $500,000 and interest since 1890. It was alleged that this sum represented the value of 266 shares of preferred stock of the Cable Company, which Count Dillon says was promised to him under an agreement for his services in furnishing valuable information and assistance in establishing the company and conducting its affairs.

THE EDISON MIMEOGRAPH PATENT SUSTAINED.

ONE of Mr. Edison's inventions, outside of the electrical field, has been the subject of a litigation decided at final hearing last week by Judge Acheson in the District of New Jersey. This patent was granted to Mr. Edison February 17, 1880, for a "Method of Preparing Autographic Stencils for Printing." The invention has been marketed by the A. B. Dick Company of Chicago, under a license from Edison, as the "Edison Mimeograph," and it has gone largely into use. The opinion says: "That the invention was one of decided merit and is one of great utility, the evidence demonstrates." The defendants in the case were the Pomeroy Duplicator Company of Newark, N. J., and one of its customers.

It is stated that Edison since 1887 has received upwards of $40,000 royalty from the A. B. Dick Company for the privilege of marketing this device, a certain royalty being paid on each machine. The counsel for Edison and the A. B. Dick Company were Messrs. Dyer & Driscoll of this city, the case being argued on behalf of Edison and the Dick Company by Mr. D. H. Driscoll of that firm. The defendants were represented by Messrs. Gallagher & Richards of Newark, N. J.

Obituary.

PROF. FRANZ NEUMANN.—The death is announced of Prof. Franz Neumann, the Nestor of German physical science, at Königsburg, on May 23, at the advanced age of 97. Among his most important works was his "Mathematical Theory of Induced Electric Current," published in 1845, constituting one of the fundamental contributions to the science.

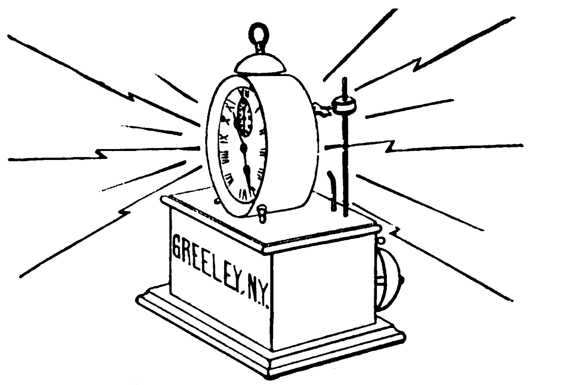
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

GREELEY'S NEW ELECTRIC ALARM CLOCK.

The E. S. Greeley & Co. of 5 and 7 Dey street, are putting on the market a new form of electric alarm clock, which has a number of excellent features.

The device consists simply of an ornamental battery box mounted in the usual way with electric bell and a time ball, which



GREELEYS NEW ELECTRIC ALARM CLOCK.

time ball is hung upon the key of the clock, the turning of which key upon release of the alarm drops the ball and completes the circuit, the bell continuing to ring until the ball is raised.

The accompanying cut fairly illustrates the article in question. Of course the clock can be set to ring the alarm at any desired hour.

"SHIP" CORED CARBONS.

THE rapid increase in the number of arc lamps on constant potential circuits is one of the marked features of the electric lighting industry, and indeed it has been predicted that eventually all arc lighting will practically be done on that system, except in special cases. These constant potential lamps, however, require a better quality of carbon than will suffice for the constant current high tension circuit lamps and hence cored carbons have come to be employed extensively, in some cases for both positive and negative, while in others for the positive carbon only.

Among those who have recently entered the American market with cored carbons is the celebrated firm of Schiff, Jordan & Co., of Vienna, Austria, the largest manufacturers in their line on the Continent of Europe. Mr. J. Jordan, representing the firm, is now in this country, and is at present on a Western trip, introducing the firm's products.

Before starting West, Mr. Jordan placed the selling agency for the "Ship" cored carbons for the United States and Canada, in in the hands of Mr. F. S. De Ronde in connection with the firm of A. De Ronde & Co., of 254 Front St., New York. These gentlemen made a careful investigation of the material before accepting the agency and are thoroughly convinced that the "Ship" cored carbons meet the claims made for them,—that of a steady, brilliant light with a minimum consumption of current.

Messrs. De Ronde & Co., desire at once to establish agencies in all parts of the United States, so that central station managers and private consumers, can have their orders filled promptly. They have made arrangements to carry a large stock of carbons so that even the heaviest orders can be filled without delay. Samples of the "Ship" cored carbons will be furnished gratis on application to Messrs. A. De Ronde & Co.

MEDBERY INSULATION.

The Fiberite Company, Mechanicville, N. Y., manufacturers of the Medbery material, is furnishing a most complete line of street railway equipment using aluminum bronze metal, and for insulation, a composition that is absolutely waterproof and practically indestructible, besides standing the highest electrical test. The company makes everything that pertains to overhead equipment of electric railways, and the fact that the works have been running twenty-four hours a day for over a year, is proof of the high standing of the products. Among the latest improved specialties attention is called to the Medbery insulated cross-overs, circuit breakers, and aluminum bronze trolley wheels. The latter are guaranteed to wear longer than any brass wheel now sold, and being made of aluminum bronze they are superior in every way to the ordinary wheels. While the metal is very soft and ductile, it is also very fine and tenacious, and will not wear the trolley wire; in fact, it is claimed that at the price these wheels are sold, they are the most economical wheel made. The company has also recently brought out a superior line of railway station switches, which are finding a ready market, and the new principles which are involved show great advancement in this direction. A full and complete catalogue can be had from the factory, or any of their selling agents.

NEW CARPENTER ENAMEL RHEOSTATS.

THE Carpenter Enamel Rheostat Company have recently put upon the market some new starting rheostats which contain some very valuable features. Their new "Spring Starting Rheostats" are so made that the contact lever cannot be left by the operator upon an intermediate contact of the rheostat. In addition to this feature of protection against burning out the rheostat, a recent invention of Mr. H. Ward Leonard is introduced, by which, while all the current needed for the motor can be secured, it is impossible to get the excessive current through the rheostat which all former types could be subjected to in the hands of unskilled or careless operators. The Carpenter Company claim that it is practically impossible to burn out their new spring starters except by deliberately setting about it.

A second type of rheostat just marketed by them is the "Leonard Automatic Rheostat. This rheostat is claimed to be indestructible; and it also protects the motor to which it is connected. If from any cause the current through the motor exceeds a certain predetermined amount, the circuit is instantly opened by a light, quick moving snap switch. This affords a perfect protection against overload under any and all conditions. The most familiar causes of burn out which this prevents are as follows: 1st. Operator cuts out resistance too rapidly and hence overloads motor. 2nd. When motor is running, too great a load is applied to the motor for its capacity. 3rd. Central station current is interrupted and is then later suddenly turned on again after motor has come to rest.

It is impossible to do any harm to either the motor or rheostat under any of the above conditions. After the safety device has operated and opened the circuit, it is necessary to insert all the resistance of the rheostat before the circuit can be again closed through the motor or rheostat.

A third style of rheostat the Carpenter Company is offering is the "Ball Automatic Rheostat." In this rheostat if the current fails, the circuit is instantly opened without inserting the resistance. Then the resistance must be inserted by hand before the motor can receive any current. The controlling magnet for this rheostat is not in series with any part of the motor and hence has no effect upon its speed or efficiency as former similar types have had.

The Carpenter Company report a demand for their goods which has kept their works running overtime and certain departments night and day for several months past. Many of the leading manufacturers in this country use the Carpenter rheostats exclusively and quite a number of prominent foreign manufacturers, such as Crompton & Company of London; Ludwig Loewe & Company of Berlin; Brown, Boveri & Co. of Switzerland; Union Electricitäts Gesellschaft of Berlin, and many others less well known over here, are ordering these rheostats regularly and in increasing quantities.

RAILWAY POLE AND ROSETTE PRIZE COMPETITION.

The directors of the Great Berlin Tramway Company offer six prizes of respectively 2,000, 1,000, 700, 600, 400 and 300 marks for the six most artistic designs of poles and wall rosettes for electric tramway overhead wires. Plans will be received until June 20 by Die Direktion der Grossen Berliner Pferdeeisenbahn-Aktien-Gesellschaft, Berlin, from whom further particulars may be obtained.

GROOS & GRAF, BERLIN.

Groos & Graf, the well-known makers of electrical apparatus, 25 Urban street, Berlin, Germany, have issued an elaborate catalogue of their comprehensive list of electrical instruments, many of which are handsomely illustrated. Groos & Graf have been specially successful in the production of telephone and telegraph instruments and fittings, and medical batteries, to which a large proportion of the 63 pages of the catalogue are devoted.

OGLETHORPE, GA.—The Oglethorpe & Montezuma Light and Power Co. have placed a 500 light alternator for lighting the city and Montezuma two miles away. They are also putting in a telephone equipment for both places. The officers are J. H. Morgan, R. E. Cook, and W. Cook.

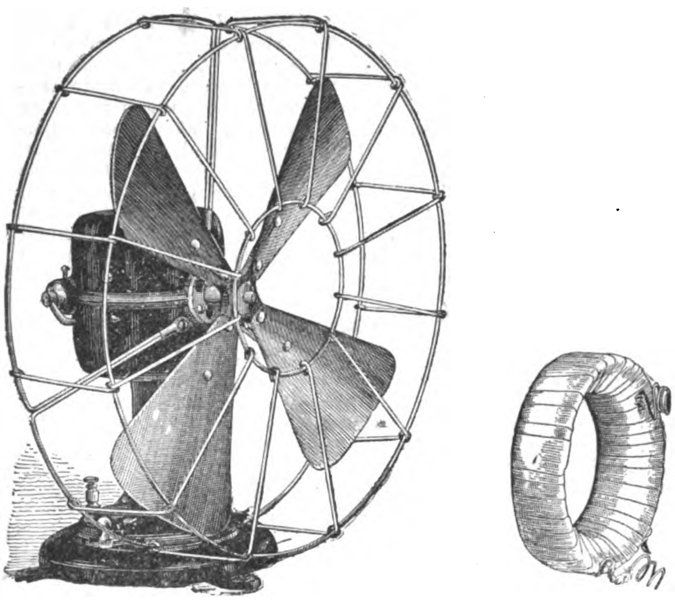
THE CALLENDER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

AT the invitation of Mr. Romaine Callender the members of the press witnessed an exhibition of that gentleman's automatic telephone exchange system in the Decker Building, Union Square, New York, on June 20. The apparatus installed showed a model exchange of 100 subscribers and the tests to which the system was put showed it capable of meeting fully the claims made by its inventor. The system was described in detail and illustrated in our issue of Jan. 9, 1895, but since that time has been still further simplified by the elimination of the "numeralizer" and by the simplification of the numerical separator.

The Callender automatic exchange will be open for the inspection of the public for a period of 30 days, beginning June 21.

THE GLOBE IRON CLAD FAN MOTOR.

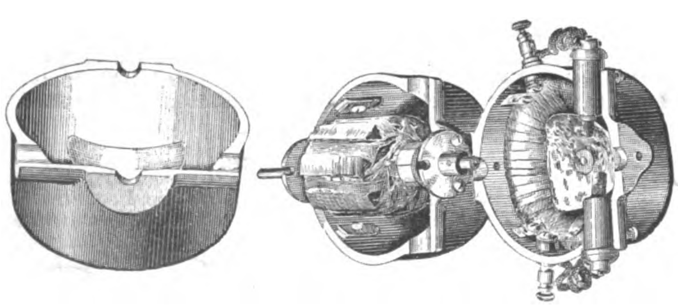
PERHAPS at no time in the past has the demand for fan motors equalled that which is now compelling manufacturers to operate their factories over-time. Among the fan outfits recently brought out is the Globe Iron Clad Motor illustrated in the accompanying engraving, Fig. 1, and the details of construction of which are shown in the parts illustrated in Figs. 2, 3 and 4.



FIGS. 1 AND 2.—GLOBE FAN MOTOR.

As will be seen, the fields are made of two castings or shells, and the field coils, wound separately, are slipped over the pole piece in each shell section. The armature is built up of the best laminated, imported iron, and a combination winding is used, the effect of which is to increase the efficiency. Carbon brushes are used on all these machines, excepting battery motors, on which a woven wire copper brush is employed. The motor is at once ironclad, dustproof and free from magnetic leakage.

One of the machines of this type, with a 12-inch 6 blade fan,



FIGS. 3 AND 4.—DETAILS OF GLOBE FAN MOTOR.

is designed to run on two cells of primary battery for 20 hours at a cost of 20 cents.

These fan outfits are built by Messrs. J. P. Williams & Co., 123 Liberty St., New York, who also build the same type of machines both as motors and as dynamos in all sizes.

As soon as the fan season is closed, the Company intend building power motors which will be manufactured up to 50 H. P. The company are at work now on a street car motor, the special features of which will be cheapness, durability, dust and water proof and no external magnetism, therefore avoiding the picking up of nails and other metallic substances in the streets. The patents have all been applied for and some of them allowed.

The Company are now well equipped for business and are guaranteeing all their goods. Mr. J. P. Williams is well known in the electrical fraternity having been in the electrical business for the past nine years, five of which were spent with the Electrical Forging Co. of Boston. It will be remembered that Mr. Williams was in charge of that Company's exhibit at the World's Fair, which was one of the features of the Electricity Building. L. A. Zimmerman, electrical engineer, is the superintendent.

NEW YORK NOTES.

THE HOGAN BOILER CO., of Middletown, N. Y., have issued a pithy and interesting pamphlet entitled "Truths," devoted to the advocacy of their type of boiler, in contrast with others, more especially those of the straight tube form. It is accompanied by tables of floor space, horse power, &c.

MR. CHARLES G. J. KING, mechanical engineer of the Chicago Edison Co., was a visitor to this city last week to receive his three daughters from Europe. He took occasion while awaiting the arrival of the steamer to visit the offices of THE ELECTRICAL ENGINEER, the New York Edison Stations, the Edison Laboratory, and a number of friends in this city. Mr. King is one of the earliest Edison men, dating back to the old Goerck street days.

MESSRS. H. B. COHO & COMPANY announce amongst the contracts closed within the last six weeks the following: 30 K. W. multipolar generator for Broadway Central Hotel, New York; 15 K. W. multipolar generator for Hotel Vandyke, N. Y. City; 30 K. W. generator for the Schnoering Apartments, W. 94th St., N. Y.; 45 H. P. generator for Henry R. Worthington, Elizabethport, N. J.; 25 H. P. and 5 H. P. motors for Alexander-Chamberlain Electric Co., N. Y.; 80 K. W. multipolar generator for Paterson, N. J.

WESTERN NOTES.

MR. W. F. STEVENS, of Saginaw (East Side), Mich., writes us that he has not, as reported, sold out his entire stock of poles but is still in the market ready to fill the largest order that can come along.

MR. B. J. LAUNIERE, formerly Secretary of the Grand Rapids Machinery & Electric Company, has recently been employed as travelling salesman by the Metropolitan Electric Company, 186–188 Fifth Avenue, Chicago. Mr. Launiere is a man of ability, well liked by the trade and is meeting with great success in the sale of electrical supplies.

THE RACINE, WIS., HARDWARE CO. reports as follows:—We are shipping many outfits and engines to all parts of the country. We are running shops overtime, and have recently placed a number of large horizontal engines of the centre crank type. We are working into the compound and larger engine business, and all we have placed so far have proven satisfactory and successful.

THE ELECTRIC APPLIANCE COMPANY have succeeded in securing the general Western Agency for another very desirable speciality, due notice of which will be given in the near future. The specialty is a staple article, for which there is a big demand, and its control and sale in the West by the Electric Appliance Company, who will carry a large Chicago stock, will place them in a position with facilities possessed by a very few supply houses in the country.

"STANDARD" STREET LIGHTING.—Nations may be ungrateful, but the chief officials in some Western cities are not so constituted judging from a letter received by the Standard Electric Company, Chicago, from which we extract the following: "The Standard arc dynamo we bought of you has been in constant use in all-night service, since November, 1893, and has not cost one cent for repairs. I find it more economical to operate—in the amount of power required—than any other dynamo we use."

BOSTON NOTES.

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Sheet 1.	GENERAL CLASSIFICATION OF DATA SHEETS.	

5761 Sheet 1.	TROLLEY LINE CONSTRUCTION DATA.	B.

List of Line Material Required in Overhead Trolley Construction.

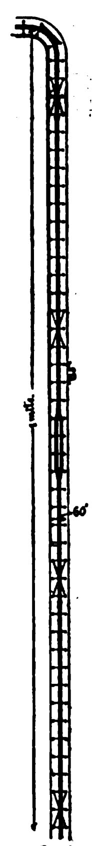


Fig. 1.

The line material that will be required for one mile of single track, 60 ft. roadway, having one curve and one turn out, and with one feeder tapped 3,520 ft. from the beginning of the road as shown in Fig. 1.

Line material that will be required for double track one mile, 100 ft. roadway, having one curve and one cross over with two feeders, one tapping it at 1,760 ft. and the other at 3,520 ft. from the beginning of the line; as shown in Fig. 2.

Single Track.		Double Track.
94	Poles 125 ft. apart total No..	94
94	Pole clamps or eye bolts....	94
98	Span wire clamps or hangers	189
1	Feeder ears..................	4
114	Strain insulators...........	114
3	Splicing ears...............	6
31	Feeder insulators...........	42
9	Pull overs..................	9
94	Guard Wire insulators.......	92
94	Guard Wire Pole Clamps or eye bolts..............	92
2	Trolley frogs...............	2
5,537 ft.	Trolley Wire No. 0 B. & S. hard drawn copper......	11,154 ft.
4,990 "	Span Wire No. 1 B. & S. galvanized iron..........	7,068 "
3,620 "	Total length of feeders....	5,580 "
1	Lightning arrester..........	1
8,357 ft.	Guard Wire No. 8 B. & S. galvanized iron..........	15,642 ft.

The above material is required for overhead construction having two lines of poles one on each side of the roadway with four anchors, and with guard wires over the whole system. This table can be readily applied to more intricate roadways by adding material for extra cross overs, curves or turn outs.

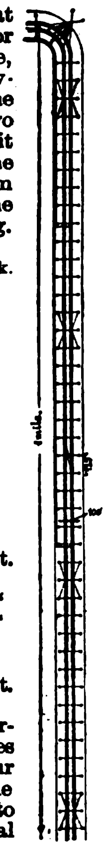
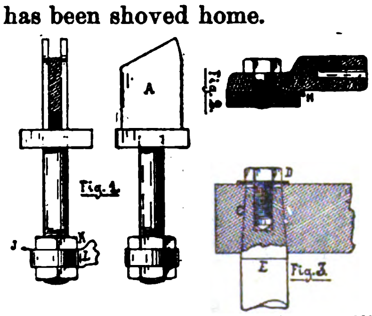


Fig. 2.

5862 Sheet 1.	GENERAL SWITCH DATA.	B.

The most prevalent American forms of contacts used are shown in Figs. 1, 2, and 3. In applying the following data to contacts, it must be borne in mind that the mechanical fitting of the contacts has as much to do with their conductivity as good design. The blade in the jaw switch should have a uniform pressure on it, and the clips should bear on this blade uniformly all over, and the jaw should not tend to force the clips apart, when the blade has been shoved home.



The metals forming the blade I, Fig. 1, should be such as not to grind or bind on clips A, and should require a smooth and uniform pull to withdraw the switch blade. With good workmanship and the cross sections of the adjacent conductors ample, a current density of from 60 to 80 amp. on the contact surface, will give a rise of temperature of about 20° F.; but pressure plays a more important part in contacts than surface. If the clips are weak and yielding, a factor of safety should be given over the above figures. In the form of connections, as shown at J, if the surfaces are true, and the threads on which these nuts bind are heavy enough to get a good pressure, 60 to 100 amp. to a square inch on both the thread surface and face of the nut should give ample contact.

Fig. 2. If the contact surfaces are smooth, and fit each other when screwed down with an iron bolt, the current density in H can be as high as 190 amp. per square inch. In Fig. 3, with a taper plug ground to a fit, about 160 amp. per sq. in. at the surface C will give an economical contact. If the plug E is to be inserted between two separate surfaces, the current density should not be over 90 amp. per sq. in. of actual contact.

508 Sheet 1.	TO MEASURE RESISTANCE BY THE VOLTMETER METHOD.	B.

If we have a voltmeter V of known resistance, Fig. 1, and a source of constant potential such as M. One method is to first determine the voltmeter

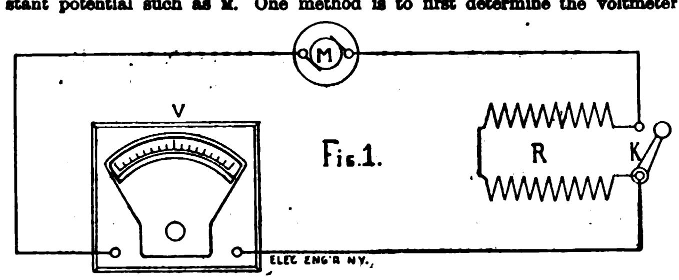


Fig. 1.

constant, which is obtained by multiplying the voltmeter resistance by the initial voltage used to measure the resistance. If we open switch K, throwing in series with the voltmeter, the unknown resistance R, the total electromotive force will be divided between the voltmeter and external resistance in the ratio that these two resistances bear to each other.

Another reading will now be observed on the voltmeter. If this reading in volts be divided into the constant for the voltmeter, and the resistance of the voltmeter be subtracted from this quotient, it will give the value in ohms of the unknown resistance R. Thus

$$\text{Unknown res.} = \frac{\text{Voltmeter resistance} \times \text{initial voltage}}{\text{Volts after unknown res. is in series}} - \text{Voltmeter res.}$$

Or use this formula:

$$\text{Unknown res.} = \text{Res. of voltm.} \times \left[\frac{\text{Initial voltage}}{\text{Volts after unknown res. is in series}} - 1.0 \right]$$

In using the voltmeter for testing for grounds, it should be connected up as in Fig. 2 after the initial voltage of the circuit is known. It is necessary in this

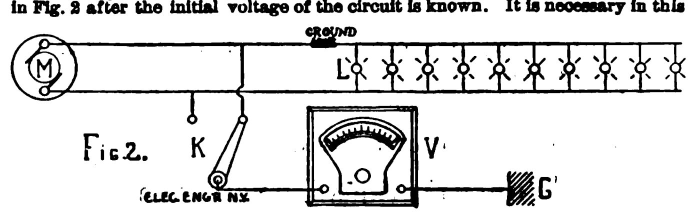


Fig. 2.

case to test both sides of the circuit to ground, for if there is a ground on the positive side, and positive side is connected to ground, there will be small or no deflection, depending upon the difference of potential between the ground and the point of testing; whereas, between the negative and ground nearly initial potential will exist showing nearly dead ground on positive side of the system.

If indications show voltage to ground higher than the initial voltage at that point, the formula does not apply: it shows that the ground is either nearer the point of generation than the point of test, or an interference with other systems.

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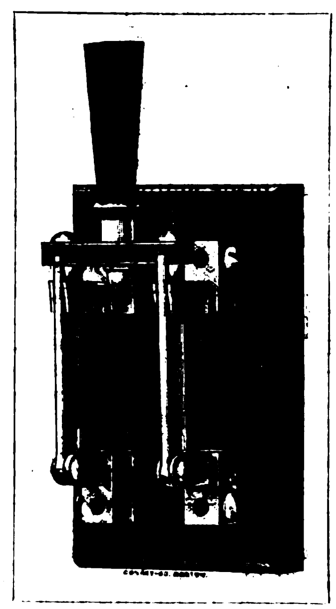

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